AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. IV. No. 3. BOSTON, JANUARY, 1905. One Dollar a Year.

BATTERY LIGHTING OUTFIT.

FREDERICK A. DRAPER.

A very common desire of amateurs interested in electricity is that of a small lighting outfit, with accumulators or storage battery as the source of current. Many have hesitated to attempt setting up such an outfit, being deterred from so doing by the supposed difficulties of charging the battery, as they do not have recourse to a charging dynamo or lighting circuit. Where the above condition exists a charging battery composed of "gravity" or other cells, can be used, the chief objection being the long time required for charging. As the demand on the storage battery is generally but a few hours at a time, the charging battery has the remainder of the time for keeping the storage battery fully charged, so the matter of time is not as important here as it otherwise might be.

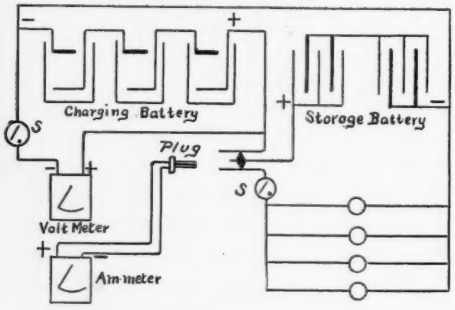
The outfit to be described contemplates the use of 10-volt, 6 C. P. lamps fitted with full size base, thus allowing standard plugs, sockets and fixtures to be used, which may be purchased at less cost than those known as "miniature." This voltage will require five cells of storage battery, and as a serviceable and easily made type was described in the June, 1904, number of this magazine, readers are referred to that article for directions for that part of the work. The making of a "gravity" battery was also described in the November, 1901, number, and as quite a number of cells are required, they can be made at a considerable saving if materials can be readily and cheaply procured; otherwise it would be best to purchase them complete.

The storage battery mentioned is of 15 ampere hours capacity; that is, it will furnish a continuous current of one ampere for 15 hours, two amperes for half that time, etc. As the lamps mentioned above require from .7 to .9 ampere each, we can easily calculate the number of lamps and the length of time for which the battery will supply current. Neglecting the resistence of the circuit, which would be small, it would be well to allow one ampere per lamp per hour, and as too fast a discharge rate is injurious for the battery, four lamps is about the largest number that can be used at a time, as nearly four hours could be obtained from each charging. As the charging battery is constantly at work the service mentioned can easily be obtained. By using lamps of less voltage and candle power, fewer cells in both storage and charging battery would be required. For lamps of 6 volts and 3 C. P., only three cells for the storage battery would be necessary.

In calculating the number of "gravity" or charging cells required, it is necessary to first determine the discharge rate of the storage battery. If the latter is to be used to about its full capacity each evening, the charging battery must have a greater number of cells than would be the case if only half the capacity was used each evening or the full capacity every other evening, and it may be well to state that if fitted up for the service last mentioned it is perfectly feasible to have service in either of the two ways. If the storage battery is used one evening to its full capacity, double the time is required for charging with the smaller battery as with the larger. With this explanation we can now determine the number of cells needed for the charging battery.

The discharge rate of a single "gravity" cell is

about .5 amperes, at a trifle under one volt. The charging current should be about 2.5 volts per cell, making the voltage of the charging current 12.5 volts; which is what is obtained from 14 "gravity" cells when connected in series. At the rate of .5 ampere, 30 hours would be required to charge the storage battery; double the number of "gravity" cells connected in series-parallel; that is, two sets of 12 each in series connected in parallel, would do it in 15 hours. The reason is plain, therefore, why such a large number of charging cells are required.



WIRING DIAGRAM.

The battery described in the July, 1903, number of this magazine should work well as a charging battery, although the writer has had no personal experience with its use in this way, and has been able to obtain a discharge rate of a trifle less than 1.5 amperes, but even at this rate only 10 cells would be required to charge the storage battery to its full capacity for daily use. Those making up all the outfit are recommended to give this type of cell a trial, as the cost is very little

Having completed our batteries, the next thing to require attention is the assembling and wiring, together with the necessary switches, etc. A volt and am-meter of suitable capacity would add much of interest in the operation of the outfit, and as well-made instruments of the required capacity can be obtained at little expense, they should certainly be included. The batteries should be placed in a suitable cupboard, the interior having first been painted with asphaltum paint, making it acid-proof. Two large shoe packing cases fitted with shelves will answer the purpose excellently. The wiring and several connections are clearly shown in the accompanying diagram. It will be noted that the lamps are connected in parallel. Ordinary annunciator wire, No. 16 gauge, will answer for wiring if not over four lamps are connected, the wires being separated an inch or more and wrapped with electricians' tape, where tacked to supports or, better, carried on small insulating knobs. Sold erall joints, as twisted joints are apt to corode and cause unnecessary resistance.

Having assembled the batteries and completed the wiring, the electrolyte poured in, charging should be started at once and continued without interruption until the plates are formed. About two days will be required for the first charging, a less time with each subsequent charging, until the normal working condition is reached. At first the positive plates will quickly become a dark brown color, changing to a lighter color, and then gradually darkening to a deep brown. The negative plates will, at the same time, turn to a dark grey and are then fully charged. They should be immediately discharged by means of the lamps, not by short circuiting, and then charged again. If time will permit before the second charging, it is of considerable benefit to the life of the plates if they are taken out, thoughly washed in water and allowed to dry for a couple of days before again being placed in the electrolyte.

William Henry Bishop, U. S. Consul at Genoa, Italy, reports: There was established here some five years ago by private parties an enterprise called the Controllo Permanente Italiano, the Italian Society of Permanent Chemical Inspection, for the analysis of food products and official certification of their purity. The commercial firms subscribing to it stamp their food products with its guarantee, and a purchaser has at any time the right to request free an analysis of any sample he may send in. The enterprise has obtained the adherence of a very considerable number of the best houses and controls food preparations to the number of 500 different kinds. It is expected that the confidence thus aroused will give the subscribers a great advantage over others in the market; and should the system become general it would greatly smooth the way of the inspection of Italian food products in the United States.

NOTE.- Owing to an accident to toe drawings, the chapter describing the engine for the touring cor, by Mr. R. G. Griswold, is omitted but will appear in Feb. issue.

WIRELESS TELEGRAPHY EXPERIMENTS.

H. E. DILL.

The writer, not long ago, when experimenting with devices to gather in the waves at the receiving end of a wireless station, utilized the receiver and transmitter illustrated in the following diagrams. A description is here given, not so much to exploit results accomplished, as to give to the hundreds of AMATEUR WORK readers now studying along the same lines the value of a co-worker's efforts. The receiver, while not perfectly satisfactory at all times, has proved more sensitive than any coherer it has been the writer's pleasure to make, but needs further development before it will be susceptible to systematic tuning.

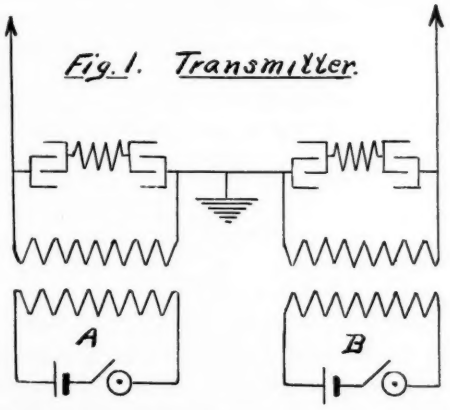


Fig. 1. Transmitter.

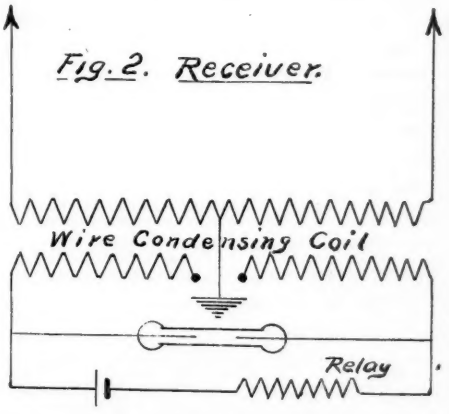


Fig. 2. Receiver.

In the study of condensers we find that the value of the unit of capacity is derived from the relations between the charging current and the E. M. F. produced by it at the terminals of the condenser. And we find the time element a factor in computing condenser capacity, inasmuch as the current strength has to be multiplied by the duration of the charge in seconds.

It is to be presumed that a receiving condenser to operate successfully as a collector of disperser waves must be constructed to operate in harmony with the radiating waves at the dispersing end. Therefore, we must first note the character of the originating high potential discharge, which is of high frequency from the one coil and low from the second. The primary voltage is 20 and amperage 10 in each case. The interruptions in coil *A* are always exactly proportioned to the interruptions in coil *B*. This is brought about by mechanical means.

The capacity across the secondary gap in each coil is .0005 M. F. With this duplex sending device a distinctive wave is emitted which, varying in prearranged frequency and differing in penetrative character from any wave that may be dispersed from one coil, makes it a powerful wave to send and a difficult wave to intercept.

At the receiving end two wires also are erected as in Fig. 2. The receiving condensers consist of twin No. 40 covered magnet wire coiled on a glass tube and the entire device immersed in kerosene oil. The receiver itself is connected in series with the condensers and consists of platinum wire points in a vacuum tube about the size of common thermometer tubing. Bridged in parallel with the receiver, is a battery of 50 volts and 8 amperes and on the reception of the wave at the condensers, a discharge (invisible) takes place at the platinum points, and a restricted portion of the heavy battery current finds its way across the gap, thus completing a circuit through the 5,000 ohm relay which, in turn, controlls a recording device, as in other systems.

The writer finds that a wave from the Slaby-Arco-Braun equipment, such as is in use at U. S. na-

val stations, will enter on either or both receiving wires and pass to earth without operating the receiving circuit, for reasons plainly evident in the diagram. But the two distinct waves that blend in their course from the duplex coils to the receiving station, seek a natural course down the wires arranged for each wave when they reach the receiving arials. And not until the same conditions of syntonism prevails at the receiver as at the transmitter is the relay supposed to respond.

THE LEYDEN JAR.

JOHN E. ATKINS.

When two sheets or plates of metal are arranged parallel to each other and but a small distance apart, and then connected with a source of direct electrical current, the plate connected to the positive supply lead will receive a positive charge of static electricity, and the other plate a charge of opposite or negative polarity. If now the source of supply be stopped the plates will discharge back again to their original condition. The property of retaining such charges is termed "capacity" and is in evidence wherever two current bearing circuits are in proximity. The unit of capacity is the Farad. Capacity depends upon the area of the plates, the kind of insulation separating them, and also the nearness of the plates to each other. As the plates touch the insulating material, the nearness of the plates equals the thickness of the insulating material.

It is possible by mathematics and reference to a table giving the specific inductive capacity of the dielectric or insulating material, to calculate the capacity of any condenser. For example: Capacity in farads equals .000000000000225 times the area of the facing surface of one of the plates multiplied by the specific inductive capacity of the dielectric, divided by the distance between the plates. From this equation we may compute that a condenser of one farad capacity would be an enormous affair, being possibly 500,000,000 square feet, when constructed in an ordinary way. The unit, one farad, is too large to deal with in practical work, therefore one-millionth of a farad (micro-farad) is the practical unit. This gives us fewer figures to handle in computing the capacity of Leyden jars or glass plate condensers.

The specific inductive capacity of glass varies from three, for ordinary glass, to 10 for extremely dense flint stock, and for ordinary calculations it is well to figure on a basis of six, which is a fair average. Consequently, assuming that we have two thin metal plates, size 5 x 8 in. and separated by a sheet of good glass $\frac{1}{8}$ in. thick, and having what we will assume to be a specific inductive capacity of six (although we may be cut a point or two in our assumption), we have this equation:

Capacity in micro farads equals .000000225 (5 x 8 or 40) times 6, divided by $\frac{1}{8}$.

In the construction of a Leyden jar, which is more compact than a glass plate condenser, the same rule follows. The thicker the glass, the less the capacity. The less dielectric or insulative value to the glass jar, the less the capacity. The larger the surface of the metal or tinfoil, the greater the capacity. Note the word "surface." Thickness of the metal has no value. In fact, some theorists claim the static charge refuses to stay on the metal at all, but clings altogether to the dieletric substance.

Now let us construct a Leyden jar of a battery jar that measures just 4 x 5 in. inside and $\frac{1}{8}$ in. thick. The glass is lard, and when rubbed briskly with a silk cloth gives a spark noticeable in a dark room. We may presume the specific inductive capacity to be 6, although it may be 5 or even 4, or possibly more than 6. We propose to coat the jar and sides up to 4 in. of the top with foil, both inside and out. This figures out, bottom area or facing surface, 4 x 4 x .7854 equals approximately 13 sq. in. Side surface, 3.1416 x 4, or 13, multiplied by 4 high, equals 52 sq. in. The sum of 13 and 52 equals 65 sq. in. total surface of one plate.

By simple mathematics we ascertain that the capacity of the Leyden jar will be approximately .0007 M. F. The amateur will now note that it

would require an exceedingly large glass jar to build anywhere near a 1 M. F. jar, consequently if such a capacity is desired we must give up the glass jar pattern and build a condenser of the thinnest tin foil and the thinnest dieletric that will stand the electric pressure. Mica is thinner than any glass we can procure and will not break, and the specific inductive capacity equals the best of glass. So we are enabled to increase our capacity in two ways; by employing a dialetric one-eighth the thickness of a glass plate, and by employing a dialetric that possesses one-half more specific inductive capacity than most glass. Thus there is an enormous gain in capacity by using mica plates and a greater expense because of the cost of mica over glass. Mica in sheets larger than 3 or 4 inches square is extremely expensive, and manufacturers by patented processes have constructed sheets of thinnest mica pieces stuck together with shellac, etc., which in many cases answer as well for dialetrics as ordinary grades of pure mica.

For condensers to give 1 M. F. capacity, it is usually the case to intermesh many small sheets of tinfoil and mica, and connecting the conducting material alternately, thereby obtaining considerable capacity within a small space. To calculate the capacity of such a condenser, multiply the surface of one metal plate in square inches by the inductive capacity of the mica, which varies, as we stated before, and multiply by the number of dialetric sheets used. Divide this by thickness of the mica in inches, say 1-64th of an in. and multiply by .000000225.

VOLT-METER MEASUREMENTS.

OSCAR F. DAME.

First of all, among electrical testing instruments, is the volt-meter, which, as the name implies, serves to measure the voltage or electromotive force of any source of electricity.

In the absence of a complete testing outfit comprising wheatstone bridge, balances and galvanometer no one instrument combines so many advantages, and for the measurement of battery strength and testing the resistance of all sorts of electrical appliances and circuits, the amateur who has become familiar with this instrument, will use it in ordinary work in preference to all others on account of its convenience and time-saving advantages. While not possessing the extreme accuracy of the expensive bridge, the accuracy of the volt-meter is close enough for all practical purposes.

The calculation of resistance with a volt-meter depends solely upon the falling off of the battery voltage when a resistance is connected in series with the test battery and instrument. A simple formula serves to reduce the difference in voltage to ohms, and as the falling off of the battery voltage is in exact proportion to the resitance of the circuit or device being measured and the resistance of the volt-meter, the following method is the simplest:

Calling the full battery voltage E, the voltage through the external resistance, e, the unknown resistance X and the resistance of the volt-meter, r, our formula becomes

$$X = \frac{E \times r}{e} - r$$

or, multiply the voltage of the battery by the resistance of the volt-meter, and divide this result by the second voltage obtained through the resistance under measurement and then subtract from this the resistance of the volt-meter. The result will be the resistance desired, in ohms.

EXAMPLE. Resistance of the volt-meter, 1,600 ohms (different types of meters vary in this resistance); test battery measures 10 volts. With a coil of unknown resistance looped into the circuit in series the meter indicates a reading of 4. What is the resistance of the coil of wire?

SOLUTION. $E = 10$, $r = 1{,}600$, and $e = 4$; therefore $(10 \times 1{,}600)$ divided by $4 = 4{,}000$. Subtract 1,600 from this and 2,400 equals the resistance of the coil in ohms.

By studying this formula closely the amateur will note that when the battery used for testing is constant in voltage, that is, remains right at so many volts without any noticeable variance, the quantity $E \times r$ becomes constant also, and the

only variable quantity is the unknown resistance, so that by working out a number of examples a table can be compiled by which one may tell, as soon as the volt-meter needle comes to rest, just what the resistance is without further mathematics. We find, therefore, that $(E = 10) \times (r = 16{,}000) = 16{,}000$. This never changes if the batteries are kept at standard.

TELEPHONE CIRCUITS AND WIRING.

ARTHUR H. BELL.

VIII. Central Energy Systems.

One of the great difficulties with magneto circuits when telephone instruments are in constant use, is the exhaustion of the battery supply at each instrument. To improve these conditions telephone electricians sought means of centralizizing the batteries at one point, and systems so designed bear the name of "common battery" or "central energy" systems.

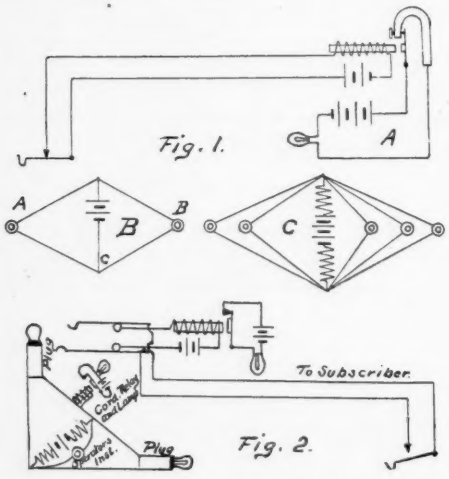


Fig. 1.

Fig. 2.

Inumerable circuits have been designed within the past dozen years to simplify the central office equipment, and the method of the "light" system, by which the operator is signalled visually by means of a small incandescent lamp, when the subscriber removes the telephone receiver from the hook, may properly be considered at this time.

The ordinary electric doorbell circuit, comprising a bell, a battery, a push button and some wire, is familiar to all. Let us presume that the doorbell is at the central office with the battery connected to it, and the push button is at the subscribers' station. The bell wire and the telephone button are analogous. By touching the push button the signal is given at central. But supposing the station is a long distance from central. Then the battery current traversing the wires will not be sufficiently strong to ring the bell.

Here enters the relay. Telephone relays act similar to telegraph relays, although their design is different. We all remember how a very feeble current reaches the relay and, after coursing the many turns on the electro-magnet, so energizes the magnet that the armature is attracted to it and thus a local circuit is caused to operate. Let us substitute a relay for the doorbell, and also bear in mind that the subscriber's receiver off the hook acts the same as a depressed push button. With the receiver off the hook the relay at central operates, and at once the local circuit, comprising battery, wiring and a miniature electric lamp, is operated. This attracts the operator's attention, because the lamps are in rows on the front of the switchboard near the "jacks" into which she "plugs in" when answering calls.

The subscriber's instrument is thus simplified by the removal of the ever-falling drops, which had to be restored by hand in many instances. Now, when the subscriber hangs up his receiver the relay armature is released, and the local lamp circuit is opened. This is clearly shown by diagram *A*, Fig. 1.

Referring to diagram *B*, Fig. 1, which can be best understood by actual experiment, we find that in a circuit so arranged *A* cannot talk with *B*, but if we insert another telephone at *C* in series with the battery, *C* will hear *A* or *B* nicely,

and *A* will be able to converse in a fairly satisfactory manner with *B*. The reason for this is, that the construction of the receiver, with its iron core and turns of wire, permits its use as an impedence coil, by which the pulsation of the *transmitted* current are impeded or choked off the battery, as they endeavor to return *via* the battery supply, while the strength of direct current is reduced only by the resistance of the circuit through which it passes. Telephone electricians, therefore, use the impedence coil in its many forms to utilize one set of batteries, as outlined in diagram *C*, Fig. 1. To thoroughly understand these circuits the reader should experiment with them.

Fig. 2 represents a more complete line circuit. It will be noticed that the jack has two inside contacts which are opened off from the springs when the plug is inserted. This operation removes the line relay and lamp circuit from the line, for the battery for talking is derived from the battery always to be found on common battery switch board cords. When the subscribers are talking the miniature relays in the cord circuit are operated, and thus the lamps' glow assist the operator in watching her subscribers as they finish conversing and hang up their receivers. This circuit will bear considerable study.

At the subscriber's station the magneto bell is often bridged across the line with a condenser in series, to keep the direct current from the exchange line relay circuit from completing a circuit and keeping the lamp lighted, and sometimes the bell is bridged between one side of the line to the ground, in which case the central operator rings with one side of her plug grounded when signalling the subscriber. In the next chapter will be given a number of diagrams, with brief explanation of each, by which any amateur possessing a few telephone parts may make apparatus suitable for practical and experimental use.

PATTERN MAKING FOR AMATEURS.

F. W. PUTNAM.

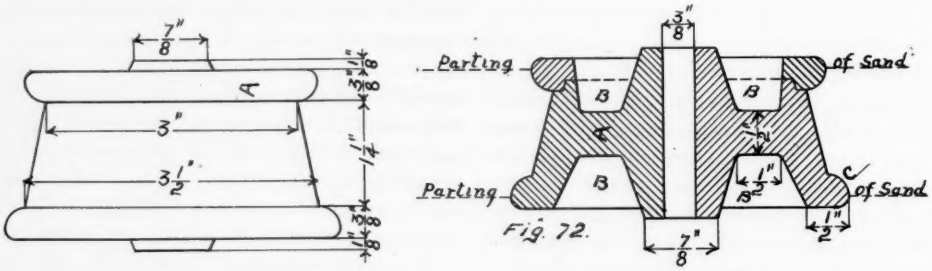
XI. A Small Hand Wheel Requiring Three-part Flask.

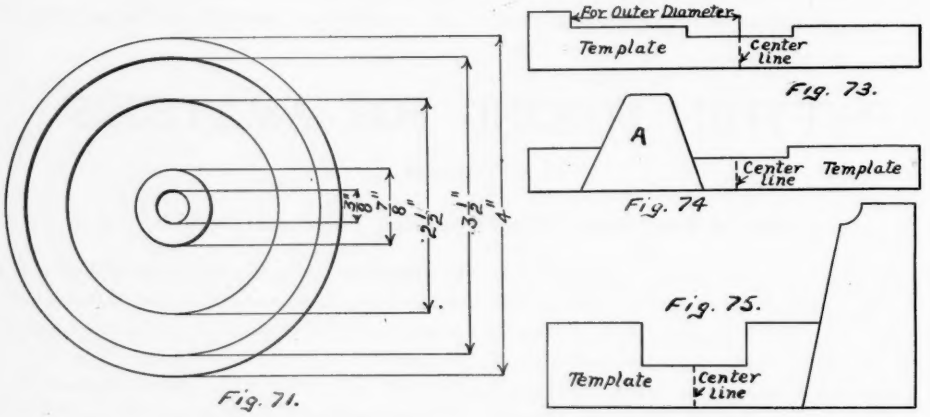
The next pattern to be taken up is that of a bevelled wheel suitable for a turn-table and is shown in Fig. 71. If we examine the top view of this figure we shall notice that the pattern will require a three-part flask. One great principle in pattern making, which should always be remembered, is to use as few loose or separate pieces on the pattern as possible and so make the parts with the greatest amount of metal inserted in the lower half of the flask. Let us examine Fig. 71 to see how this rule may be applied to the pattern under consideration.

Make the rim of the pattern at the smaller end, *A*, as a separate or loose piece. We shall find that, if the pattern is to be carefully made, it will be advisable to start at that part of the pattern known as the web shown at *A*, in Fig. 72. First, build up that portion of the wheel which will be molded in the nowell. This will be the largest side of the wheel. Saw out of boards circles sufficiently large for the work, gluing the pieces, one on top of the other, until the required thickness is obtained; remembering that where a pattern is built up the successive layers of stock are to be placed with the grain running in the opposite direction, so to prevent warping. If a larger pattern for a bevelled wheel were required, the better way would be to glue up the rim in sections or segments, as they are called. In such a case the hub would be the only solid part of the pattern and the hole for the shaft would, of course, be cored out. Having built up the stock for the pattern, the glue having become thoroughly hard, fasten the block into a chuck and turn to the required size. It will be found advisable to make two templets, as shown in Fig. 73 to 75.

The templets shown in Figs. 73 and 74 should be used first in truing up the faces and turning down the rim to the proper dimensions. The part marked *A* in Fig. 74 should be very thin, not over $\frac{1}{8}$ in. in thickness, and may be nailed or glued to the other piece. This part, *A*, is exactly the same shape as the pieces *B* in Fig. 72. These pieces are to be cut out on the other side of the

block, and the edge of the rim at *C*, Fig. 72, is to be turned. The pattern is now to be removed from the chuck and the other side built up, the block being first chucked so that the web may be evened off to the required thickness. Next build up the pattern so that the total thickness will be slightly greater than the finished pattern. It will be found advisable to build up the pattern while it is fastened in the chuck. When the pattern





has been built up and the glue has become thoroughly dry, face up and true off both the inner and outer edges. Be very careful in turning the shoulder on which the loose rim is to set, so that perfect joint may be made when the loose piece is finished. The loose piece may be made in one piece, though it is far preferable to make it from at least two pieces, so as to prevent warping to as great an extent as possible.

The stock for the loose rim should be chucked and turned down so that the rabbet, which is necessary in order that the loose rim may be set on the rest of the pattern, will fit evenly to give the exact thickness for the total pattern.

The templet shown in Fig. 75 is used to test the exact shape of the outside of the bevelled wheel, and should be carefully made. The loose rim must turn freely, having a very small amount of glue, as it is glued so as not to stick to the main part of the pattern.

The core prints are, of course, turned separately and fastened to both sides of the pattern. The core box is not shown, as it involves no new work and no trouble should be experienced in making it.

The use of blast furnace gas for engines has made considerable growth in the last ten years. It is estimated that a furnace making seven tons of iron per hour, or 168 tons per day, generates enough gas to furnish 5880 horse-power continuously, not counting the gas used for heating the blast and operating the blowing engines. Engines suitable for this work can now be obtained direct connected to electric generators of 6000 horse-power capacity, and it pould seem that tnis form of engine might come to be used extensively for power purposes.

The stationary gas engine, as power for small plants, is frequently replacing the steam engine.

A SMALL DESK.

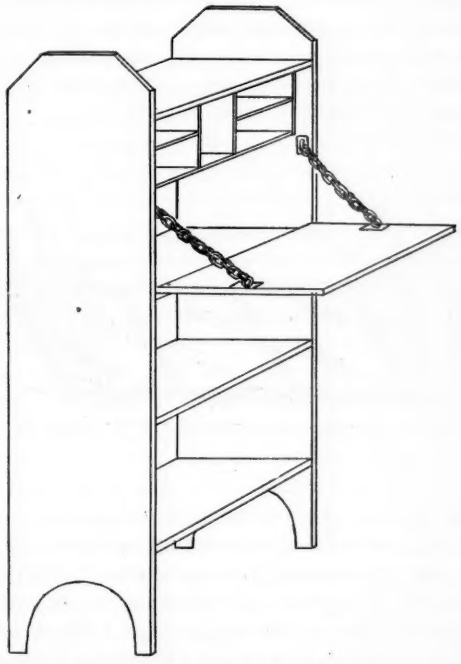
JOHN F. ADAMS.

The design for the small desk here described is such that the construction is easy, and may be attempted with confidence by anyone having but ordinary skill in wood working. If care be taken in cutting the pieces to the right lengths and with square angles, a very satisfactory job will result. For these reasons it is thought that many readers, who are students in manual training, will find the design one which can be utilized by them in the construction of a useful piece of furniture. Oak is the most suitable wood, although gum wood is excellent.

The side pieces are 50 in. long, 12 in. wide and $\frac{7}{8}$ in. thick, the curved openings at the bottom being 6 in. high and 8 in. wide. Have these sawed out at the mill, sending a drawing with the order. The bevel at the top is 3 in. each way or 45°. The four cross-pieces are $24\frac{1}{2}$ in. long, $\frac{7}{8}$ in. thick; two 12 in. wide and two $11\frac{1}{2}$ in. wide. The wider pieces are for the top and bottom pieces and have $\frac{1}{4}$ in. rabbets cut on the back inner edges for the backing, which is of $\frac{1}{2}$ in. matched stock. Grooves $\frac{1}{4}$ in. deep are cut in the side pieces to receive the ends of these cross-pieces the upper piece being 5 in. from the top, the second $14\frac{1}{8}$ in. below the top one; the third and bottom one are spaced 10 in. apart, leaving a $8\frac{1}{2}$ in. space under the lower shelf.

The drop-shelf is 24 in. long, $14\frac{1}{8}$ in. wide, and will have to be glued up from two pieces. At each end cleats 2 in. wide and $\frac{3}{8}$ in. thick should be fitted to corresponding rabbets cut on the upper side. These cleats should be carefully fitted, glued up and kept in clamps until the glue is thoroughly dry.

The pockets inside for paper, etc., may be made of maple, finished natural to give a contrast, or of oak and stained, as preferred. The stock is $\frac{3}{8}$ in. thick and 10 in. wide. Two pieces $23\frac{1}{4}$ in. long, two pieces 9 in. long, two pieces $6\frac{3}{4}$ in. and two pieces 6 in. long, are needed. The two end pieces should be nailed to the ends of the cross pieces, the other two vertical pieces are then nailed in place after nailing to them the ends of the two short shelves, the other ends of the latter then being nailed through the end pieces. This frame is then attached to the desk with screws put through from the inside. It may also be supported by a $\frac{1}{2}$ in. square strip screwed to the backing when the latter is in place. The backing should be in strips $36\frac{1}{2}$ in. long and enough is needed for a width of 24 in. and is nailed on with small finish nails.



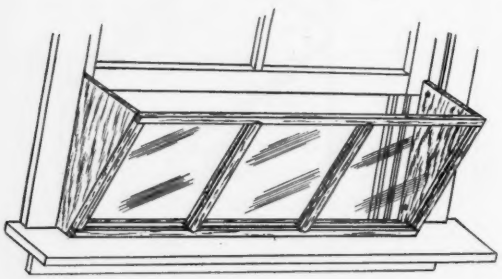
The drop leaf is attached with ornamental T hinges of brass or black iron, as may be most conveniently obtained, and also with suitable side chains, as shown in the illustration. A lock is fitted to the outer edge. Stop blocks are glued to the inside upper corners of the case to hold the drop leaf flush when same is lifted.

Hhlland has abolished ail restrictions regarding the speed of automobilns in the country, thus placing the entire responsibility upon the driver.

A WINDOW VENTILATOR.

JOHN F. ADAMS.

The proper ventilation of the living and sleeping rooms of a residence during snowy or rainy weather, requires some arrangement which will permit the fresh air to enter and yet keep out snow or rain. It is also desirable to be able to close the window without having to remove or adjust the ventilator. The arrangement here described possesses these requirements, and is also quite easily made at small expense. Its general construction can be seen from the illustration, and as windows vary so greatly in size no dimensions will be given, as anyone making it can readily determine what they should be to fit the windows where they are to be used.



It will be noted that the front side is at an angle of about 65° from the vertical, so that the simple raising or lowering of the window is all that is needed to regulate the volume of air entering the room. Also, as the upper edge of the ventilator is higher than the lower edge of the window, the air current takes an upward turn, and snow or rain will fall against the glass front and thence to the bottom. In very windy weather the window is raised only sufficiently to admit the air.

For windows of ordinary size the height of 10 in. will answer; the two end pieces then being 10 in. high, the upper ends 6¼ in. wide, and the lower ends 2 in. These are connected with a narrow piece at the bottom 2 in. wide and ¼ in. thick. The frame for the panes of glass are made of strips ⅞ x ⅝ in., in which $\frac{3}{16}$ x ⅜ in. rabbets have been cut where necessary. The corner joints at the ends are halved; the two dividing pieces are fitted with V-shaped ends, the proper grooves being cut in the long pieces to receive them. They are permanently fastened by boring ⅛ in. holes and pinning with dowel pins glued in. The frame is then fastened to the ends and bottom strip with wire finish nails.

The panes of glass are held in place with strips of wood, which should just fit the remaining space so that the edges will be flush with the frame. These strips are nailed with small brads. Those on the lower part should be bevelled to avoid forming a ledge, which would hold the rain or snow running down the glass. For the same reason, the bottom board might be inclined slightly. The only varnish which will stand the elements is spar varnish, two coats, at least, being necessary. The ventilator is fastened to the window by two screws put through each end piece, one near the top and the other near the bottom.

What is said to be the largest tree in the world is reported from Tulare County, Cal. This giant sequoia measured 36 feet in diameter and 113 feet in circumference 4 feet from the ground. According to the press dispatches announcing the find, the mill man who discovered this majestic forest monarch will turn it into lumber. This is unquestionably a commercial age, and dollars and cents largely constitute the criterion by which almost everything is judged, yet it certainly seems that some means should be provided to prevent the destruction of such a patriarch. For 4000, possibly 5000, years this sturdy, symmetrical shaft has reared its green head, braving alike the lightning's bolts, the fury of the tempest and the fierce rays of the sun, standing today as the most inspiring example of that great pulsating life that seeks expression everywhere in nature.

A little work during leisure time will secure premiums of useful tools.

PHOTOGRAPHY.

CHOICE OF A DEVELOPER.

JOHN EVERARD.

The amateur photographer, still on the threshold of our fascinating art-science, often finds himself in a predicament when necessity demands that he should purchase a fresh supply of developer, the supply included in his newly acquired outfit being exhausted. Should he be unacquainted with a seasoned photographer from whom to seek advice, he will probably rely on the dealer's recommendation, and, although the assistance given by the latter gentleman is often of considerable value, the vendor of the developer cannot be expected to burden himself with the cares of the newly-born amateur. Therefore, it very often happens that instead of obtaining a developer of easy manipulation, and possessing these possibilities of control so essential to a beginner, he is hurried towards failure by using an unsuitable developer—unsuitable because in his embryonic stages he lacks the technical knowledge required to use that particular developer to the best advantage. It is said that "patience is a virtue" in all occupations, but so few pursuits require so much endurance as photography, particularly the development of film and glass negatives. But development is the stage in the operations wherein the greatest impatience pervades the mind of the amateur, who is naturally aglow to see the result his efforts. And, because that impatience may be quickly overcome by the employment of a rapid developing agent, he gratifies the desire to "see what it is like" by purchasing a "quick-action" developer, being entirely ignorant of the fact that, to use such developers successfully, the worker must possess a considerable amount of skill. I refer particularly to those agents with which a correctly exposed plate may be fully developed in two minutes or thereabouts, and by their rapid action completely turning the mind of the inexperienced worker into a chaos of misgivings as to whether the plate is over-exposed or only fully developed. It may appear to the reader that I would discourage the use of such developers; for the raw beginner, yes; but not for the practised worker acquainted with their characteristics.

Let us suppose we are in the dark-room, standing by the side of a few-days-old amateur, and that he is using a metol developer. He slowly measures out the prescribed quantity of solution, finally adding a drop or two of bromide restrainer. Next, carefully, but seldom quickly, (although it is very necessary to cover the whole surface of the plate quickly when using this developer), he pours the solution over the plate. A few seconds pass, then the high lights appear; another few seconds go by, and the image is fully developed, but, because of the rapidity with which the detail has appeared, he cannot make up his mind whether the plate is over-exposed or merely fully developed. If such an occurrence takes place when treating a correctly exposed plate, how much more difficult his task will be when too much or too little exposure has been given.

But imagine him developing a negative with a slow developer. The coming of the high lights and the subsequent attainment of density are very gradual, allowing frequent examination, and the interval between the first appearance of the image and the final degree of density is such that it will give the untried worker reasonable time to consider whether the plate is fully developed, over or under-exposed, and to treat it accordingly. For the sake of precision, and to assist the amateur in elucidating these remarks, concerning the use of slow and quick-action developers, I will resort to the system of classification, although it cannot be expected that every agent will be fully dealt with.

These are the most universally used slow developers, though, especially in the case of the first named, the quantity may vary considerably, thus

lessening or lengthening the time of development. As an ideal developer for the early worker and one that will allow him plenty of time, pyro cannot be beaten; and, although there are many who will probably disclaim its use for the beginner, in my opinion such repudiation is unnecessary. The very fact that the greater proportion of professional photographers still use pyro should be sufficient inducement to the amateur to do likewise. Its staining properties may be guarded against, whilst its suitability for all printing processes is a well-known fact. The correct proportion of pyro-soda and other developers are given below.

Hydrokinone is also very slow in its action, but has the peculiar property of adding density very quickly, once the image appears, and, unless the plate is continually examined, produces a hard negative in a very little while. It is so easy to over-develop with hydrokinone that beginners should be extremely cautious, and use it warily. Much the same advice may be given to those who would adopt eikonogen—over-development being very frequent unless care is exercised. The addition of metol to hydrokinone, and the combination of hydrokinone with eikonogen, seems to have the effect of decreasing the chances of over-development, at the same time increasing the rapidity of action.

These are probably the most rapid developing agents extant, and the first named is so energetic that a raw beginner will experience difficulty in exercising the necessary control. Amidol, although very popular in bromide work, is often retailed as a developer for negatives, but because it has a tendency to deteriorate when made up in solution, its use will never become so general as the first-named agent. Ortol is often recommended as a developer for films, and I have found it exceedingly useful for that purpose; nevertheless, its energetic action will scarcely commend itself to other than practiced workers.

There are numerous other agents which, in the hands of seasoned amateurs, are capable of producing the finest results. I refer to adurol, rodinal, glycin, edinol, etc., but these may be classed as rapid-aetion developers. The combination known as pyro-potass-metol is, without doubt, a most successful developer for snap-shot work, and, when the embryo has mastered pyro-soda, he should use the former for developing his instantaneous exposures. Being a quick-action developer, he should not use it at the outset, lest its energy promotes confusion.

The chemicals contained in the following formulæ are intended to be mixed: the ingredients of each formula with two ounces of water, which quantity is sufficient to develop one half-plate:

PYRO-SODA.

Pyrogallic acid	4 gr.
Sodium sulphite	16 gr.
Sulphuric acid (not necessary if developer is for immediate use).	
Sodium carbonate	22 gr.

HYDROKINONE.

Hydrokinone	6 gr.
Sodium sulphite	36 gr.
Potassium carb.	44 gr.
Potass. bromide.	½ gr.

EIKONOGEN.

Eikonogen	7 gr.
Sodium sulphite	42 gr.
Sodium carb.	74 gr.
Potass. bromide	½ gr.

METOL.

Metol	4 gr.
Sodium sulphite	44 gr.
Sodium carb. crystals	26 gr.
Potass bromide.	2 gr.

AMIDOL.

Amidol	10 gr.
Sodium sulphite	100 gr.
Potass. bromide	1 gr.

ORTOL.

Ortol	4 gr.
Sodium sulphite	32 gr.
Sodium carb.	32 gr.
Potass bromide	1 gr.

PYRO-AMMONIA.

Pyrogallic acid	4 gr.
Potass. bromide	½ gr.
Ammonia liq.	.880, .16 m.

METOL-HYDROKINONE.

Metol	2 gr.
Hydrokinone	2 gr.
Sodium sulphite	48 gr.
Sodium carb.	30 gr.
Potass. bromide	½ gr.

PYRO-POT.-METOL.

Pyro	1 gr.
Metol	2 gr.
Sodium sulphite	12 gr.
Potass. carb.	12 gr.
Pot. bromide	½ gr.

EIKONOGEN-HYDROKINONE.

Eikonogen	6 gr.
Hydrokinone	1 gr.
Sodium sulphite	54 gr.
Potassium carbonate	28 gr.

In every case the preservative should, first of all, be dissolved; then the agent, and, lastly, the potassium bromide or restraining agent.

The following notes concerning the characteristics of developers, such as tint of negative obtained, of developers' keeping qualities, etc., etc., are inseparable in this treatise, and the beginner will do well to instill into his mind the peculiar properties of each. It is common knowledge that the tint of the negative is an important factor in printing, and a yellow-tinted but under-exposed negative will often give a better print than an under-exposed plate of a grey-black tone.

Pyrogallic Acid.—The brown-yellow image obtained with this agent is suitable for any printing process now on the market, and it is because of such utilization that pyro has enslaved the affections of the professional photographer. Pyrogallic acid is generally used with sodium carbonate and sulphites or liq. ammonia. Exposure to air will turn pyro in solution, yellow, and in this state it will considerably deepen the tint of the negative. An excess of pyro will produce a yellow stain, at the same time accentuating contrasts. Too great a proportion of the alkali (sulphite' etc.) is productive of flat, weak negatives.

Hydrokinone.—Hydrokinone produces a brown-black image, and unless the negative is examined very frequently, over-development (causing density and too much contrast) will mar the result. Like pyro, hydrokinone, when made up in solution, will turn brown on exposure to air, but in this case the discoloration does not affect the energetic properties of the developer. The alkalies generally recommended for hydrokinone are caustic soda and potass. carbonites and sulphites. Regarding the former, too free a use of the caustic will soften the emulsion of the negative. and excessive forcing often produces a disagreeable yellow stain.

Eikonogen.—Grey-blue negatives are obtained with eikonogen; the alkaline solution being generally composed of neutral sulphite and carbonates. In all other particulars it resembles hydrokinone.

Metol.—Metol produces a grey-black negative, and is used with alkaline carbonates. In solution metol keeps well. As a developer its use is very popular, both for plates and bromide papers.

Amidol.—Negatives of the grey-black tint are obtained with amidol. It is an ideal developer for bromide papers, but in solution its keeping qualities are not good. If the solution assumes a a reddish tint, it should be thrown away, for in this state its energies are practically exhausted.

Ortol.— Ortol possesses similar properties to metol, and is used in much the same manner.

I believe it has been pointed out before in these pages that exactitude is essential, but I should also like to add that unless the observance of this rule is rigidly self-enforced, defective negatives will often make their appearance. Should you use more of the principal agent than is recommended, you will find too much contrast in your negatives, and the light portions will be clogged. Again, if too little is used your negative will lack brilliancy and you will generally find development unnecessarily prolonged.

If you will add more than the prescribed quantity of alkali, you will certainly accelerate development, but your negatives will be flat and dense while fog and granulation may also make their appearance. Be sure that you are using only the recommended quantity of water; also that the temperature of the latter is approximately 70° Fahr. A warm developer produces fog; a cold one, flatness.—*Focus.*

An experiment in botanical surgery is proceeding in California. The oaks which grow in the grounds of the University of California are of world-wide fame. Lately, however, a dry rot has caused the trustees to fear their extinction. So Prof. W. A. Setchell, of the Botany Department, set to work to operate. First, he cut out all the disease and left large cavities in the trunks. Then he filled these with cement up to the inner edge of the bark. He reasoned that if the stopping were filled in until level with the outer surface the bark would not be able to grow over it. As it is, a smooth surface is left level with the wood itself, and he expects that the bark in time will cover it. If so, it will be hard lines, in a generation to come, on the teeth of the circular saw that gets to work on them.

The moon moves with a mean velocity of 3,350 ft. per second—not so very much faster than the projectiles of our best guns travel when on business. We may in time beat the moon in the race.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

JANUARY, 1905.

A new premium list is in preparation and wil probably be ready for distrubution to our readers with the February issue. It will include a large number of new premiums, which we are confident will be found of value by those who are willing to put in a little personal effort in calling the attention of their friends to this magazine. Many of our subscribers have obtained numerous additions to their tool outfits in this way, and many others could do the same were they to give the matter attention during their leisure time.

Our premiums are all of the very best quality obtainable, and should not be compared with the inferior articles offered by some mail order houses. We have received numerous letters from those receiving premiums, expressing their highest appreciation of the value of the premiums received. Our forthcoming list will include a wide variety of useful and instructive tools and instruments, and our readers should be able to secure some of them with but little effort. In this way they will be rendering a double service, as the new subscribers will be pleased to have the magazine called to their attention, and they will personally benefit by receiving an appropriate reward for having done this. Those who have not as yet done anything in this line will find it to their direct benefit if they make the effort.

We have received several requests for a description of a small, easily-made runabout. We shall be pleased to publish a description of such a vehicle, provided a sufficient number of readers should express their desire for the same. One of our readers has constructed a light carriage fitted with a 3 h. p., air cooled motor, and with wheels of the size and type used on auto-bicyles. It will carry two adults at a good speed over the roads to be found in this country, and a similar one may be made by any one of ordinary skill at a total expense of not over $100. He has cheerfully volunteered to give us the complete description, should we desire it. We shall be pleased to have those of our readers interested in such a vehicle, write us regarding the publication of a description of the same, and if a sufficient number of requests are received, the first chapter will be given at an early date.

All previously accepted conclusions as to the therapeutic value of metals are challenged by a communication made to the Acadamy of Medicine, says the *Echo de Paris*, by M. Albert Robin. He declares that metals, when administered to the human subject in doses so minute as to be altogether inappreciable, exercise an influence that is almost magical and quite inexplicable by any theories hitherto known to science. The action of the infinitesimal atoms is apparently analogous to that of organic ferments, which, as is well known, possess some mysterious power quite irrespective of their quantity.

The whole region of the Great Lakes is undergoing a slow tilting. The waters of each lake are rising on the southern and western shores. At Toledo and Sandusky the advance of the water amounts to eight or nine inches in depth in a century.

TOOL MAKING FOR AMATEURS.

ROBERT GIBSON GRISWOLD.

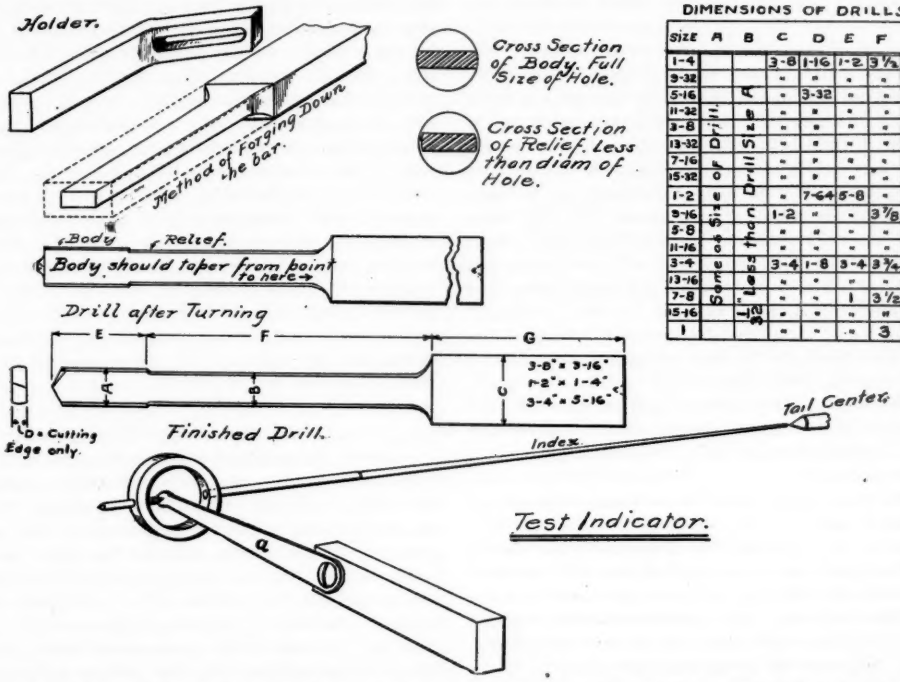
V. Set of Chucking Drills,—Test Indicator.

Any amateur who has tried using a twist drill of large diameter in a small lathe has, perhaps, experienced a few of the difficulties attending that operation, especially when the drill begins to break through; the drill is generally drawn off the tail center, canted in the hole, catches on the tool post, and frequently ends the performance by springing the piece out of the chuck or tearing it from the faceplate, provided the drill does not break. Aside from this, a twist drill is apt to feed into the work, if of brass, owing to the shape of the lip. It is true that this may be obviated by grinding the lip nearly parallel with the drill axis, but that destroys its cutting action in iron or steel, and that much of the drill has to be ground away before a proper edge can again be had. Another very important objection to twist drills of diameters above one half inch is their great cost, especially if a set of any considerable number is purchased.

The object of this article is to explain how to make a set of very satisfactory chucking drills at a very low cost. They are simply flat drills with a center at one end in which to rest the tail center. The opposite end is forged down to the size desired, which should be slightly longer than the largest dimension of the shank, and ground to a fine, true edge after hardening and tempering.

It is surprising what extremely accurate work may be done with these drills if properly sharpened and kept in good condition. Suppose we make a set ranging from $\frac{1}{4}$ to 1 in. varying by 1-32 in. up to $\frac{1}{2}$ in., and by 1-16 in. from $\frac{1}{2}$ to 1 in., which gives us a set of seventeen drills, as follows: $\frac{1}{4}$, 9-32, 5-16, 11-32, $\frac{3}{8}$, 13-32, 7-16, 15-32, $\frac{1}{2}$, 9-16, $\frac{5}{8}$, 11-16, $\frac{3}{4}$, 13-16, $\frac{7}{8}$, 5-16, 1 in. For the drills up to $\frac{1}{2}$ in. we will use flat tool steel, 3-16 x $\frac{3}{8}$ in., and make them all six inches long, which will require about 4 ft. of this stock. Cut the pieces off for each drill *after* the end has been drawn out by forging. This drawing increases the length and saves material. Make the 9-16, $\frac{5}{8}$ and 11-16 in. drills of $\frac{1}{4}$ x $\frac{1}{2}$ in., and the remaining four of $\frac{3}{4}$ x 5-16 in. stock, each finished drill being about seven inches in length.

Forge each drill down to a size a little above the finished size and make it flat, as shown in the sketch. This flat is necessary in order that the chips may clear



DIMENSIONS OF DRILLS.

SIZE	A	B	C	D	E	F	G
1-4	Same as Size of Drill.	Less than Drill Size by 1/32"	3-8	1-16	1-2	3 1/2	2
9-32			"	"	"	"	"
5-16			"	3-32	"	"	"
11-32			"	"	"	"	"
3-8			"	"	"	"	"
13-32			"	"	"	"	"
7-16			"	"	"	"	"
15-32			"	"	"	"	"
1-2			"	7-64	5-8	"	"
9-16			1-2	"	"	3 1/8	2 1/8
5-8			"	"	"	"	"
11-16			"	"	"	"	"
3-4			3-4	1-8	3-4	3 1/4	"
13-16			"	"	"	"	"
7-8			"	"	1	3 1/2	"
15-16			"	"	"	"	"
1			"	"	"	3	3

and have a chance to get out. The cutting edge may be made somewhat thinner, but not so much as to weaken it while cutting. Then cut off the drill, center both ends and place in lathe. Take a cut for the distance indicated in the table to give the drill a true body, and then relieve it slightly, as shown. This makes the drill follow in a straight hole. Unless the amateur has some means of grinding these bodies after turning, a very fine finishing cut had best be taken with a keen finishing tool wet with oil. One cannot file an irregular piece in the lathe to make a good job. The flat dimension of the drill should gradually taper from the dimension D to $2 \times D$, where it runs into the stock.

When finished to the desired shape, file down the point approximately to the angle desired, afterwards drawing the temper to a dark straw. Then grind the final cutting edge, exercising care to see that the same angle is used on both sides, and that both cutting lips are of the same length. Now make three holders, as shown in cut, one for each size stock. In using the drills these holders are fastened in the tool post, the drill stock passed through the slot, which should be slightly larger, and rested on the tail center. The point of the drill is then brought against the revolving work and fed by means of the tail or spindle. The holder permits the drill to move axially without revolving with the work. If the lips have been carefully ground, very straight, true holes can be drilled, and and the drill will not draw in when breaking through.

A very handy wrinkle to prevent the drill dropping off the center when through the hole, is to drill a hole through the stock and drive in a pin, over which latter a heavy rubber band is slipped and passed over some projection of the tail stock. If tightly stretched it will draw the drill out with it. Another scheme is to back the holder up against the pin and move the carriage with the spindle.

This set, while highly efficient and capable of good heavy work, is very much cheaper than a corresponding set of twist drills, and for all practical purposes is every bit as good.

In order that a piece may be so located on a faceplate that a hole may be drilled or bored in any definite position, it is necessary to apply some instrument that will indicate the exact amount that the center of the hole (already laid out on the work) is out of truth and in what direction. Such an instrument is called an indicator, and the one herein described is accurate, durable, cheap and easily constructed.

Make a ring of brass or steel $1\frac{1}{4}$ in. outside diameter and 13-16 in. inside diameter by $\frac{1}{2}$ in. width. Drill and tap two holes diametrically opposite for a $\frac{1}{8}$ in. screw with 40 threads, or any other tap of that diameter. Thread $\frac{1}{2}$ in. of one end of a piece of $\frac{1}{8}$ in. drill rod $\frac{1}{4}$ in. in length, and sharpen both ends down to a 60° point; then harden the ends. Make the other extension in this manner. Cut a piece of the same drill rod six inches in length and thread one end for 3-16 in.; in the other end drill a 3-32 in. hole about $\frac{1}{4}$ in. deep. Screw both of these pieces into place firmly. Now make an index out of a piece of straight-grained pine or spruce about 10 in. long, and taper it down as shown, fitting the larger end snugly to the 3-32 in hole. This pointer is very light and will move quickly without vibration. The ratio of movement is as .75 : 14 = 18.66, and the end of the pointer will magnify the error in setting 18.66 times, generally a sufficient amount for all practical purposes. An error of .001 in. in the setting will be multiplied to .01866 in., or nearly 1-50 of an inch. If greater accuracy is required the short piece may be made $\frac{1}{4}$ in. long, when the multiplication of error will be 28 times.

A holder is made as shown to press the point against the work. This holder is fastened in the tool post, and the vertical adjustment made by moving the spring a up or down, while the horizontal adjustment is secured by moving the tool-post block. Only sufficient pressure to hold it to the work should be applied.

To use the indicator, strap the piece to the face plate with the center of the hole in approximately the correct position. Then apply the indicator, adjusting the holder until the end of the wooden pointer coincides with the tail center. Now revolve the face-plate through half a revolution and move the carriage so that the pointer will approach the center by half the discrepancy. Then lightly tap the block until the pointer again coincides with the center. You have then moved the block the distance that it was off the center in that direction. Then turn the face-plate a quarter turn and repeat the operation. The block will then be practically correct, and by light taps in one direction as the other may be brought to the desired position, when there will be no movement at all at the end of the pointer. Then firmly clamp the piece in position and try again to see that the bolts have not drawn the piece out of true or sprung it.

A radium clock which will keep time indefinitely has been constructed by Harrison Martindale, of England. The clock comprises a small tube in which is placed a minute quantity of radium supported in an exhausted glass vessel by a quartz rod. To the lower end of the tube, which is colored violet by the action of the radium, an electroscope formed of two long leaves or strips of silver is attached. A charge of electricity in which there are no beta rays is transmitted through the activity of the radium into the leaves, and the latter thereby expand until they touch the sides of the vessel, connected to earth by wires, which instantly conduct the electric charge, and the leaves fall together. This simple operation is repeated incessantly every two minutes until the radium is exhausted, which in this instance it is computed will occupy 30,000 years.

Mention AMATEUR WORK to your friends.

SOME DIFFICULTIES IN GETTING ON.

JAMES SWINBURNE.

Abstracts from an address delivered to the students of the British Institute of Engineers.

Each of us is confronted with the question: "What is going to be my work?" I say "us," because the difficulty in many cases is permanent; one never knows what he will be called upon to tackle in the future. The difficulty is much greater, however, in the case of a young man, because he has probably the vaguest idea of what his life's work will be, and that idea time will show to be quite wrong.

In engineering it is quite impossible for any one to start out with a definite career before him. He is like a particular particle setting out across a containing-vessel of gas. He cannot career straight across. He is buffeted about and frequently goes in quite the wrong direction. A man who has made a specialty of electrical waves gets his first appointment as inspector of meters to an electric light company, and so on. A well-known engineer remarked to me the other day that he found his knowledge of differential equations, and his experience in the correct analysis of the rare earths was of little use in putting in sewage plant. Yet he had made lots of use both of his mathematical and chemical analysis in his time.

Probably each man should have a general knowledge of applied physics and chemistry and mathematics, and a special knowledge of one or two subjects. The special knowledge may never come in useful; but the chances are that in the blind stumblings we call our careers a specialty may be valuable. If you glance round at the work of some of our big men you will be surprised to see how many have made their reputation by doing one small thing, but doing it well.

One of the great difficulties is to keep knowledge in a polished state ready for immediate use. In practice it may have to lie idle for long periods and then be wanted very much on short notice. This fact is overlooked by people who suffer from the modern craze for writing about technical education. For instance, we are told that all engineers ought to have the calculus at their finger ends, and so on; but it is forgotten that though an engineer ought to be well up in mathematics, he only makes a calculation requiring higher mathematics once in several years, perhaps; and it is impossible for him to keep his mathematics in working order down to minutest details. All he can do is to keep general principles in his mind. The great thing is to master a certain number of broad fundamental principles which give a starting point for refreshing old knowledge or acquiring new. For instance, in physics, the law of conservation of energy and all that follows from it; the principles of the kinetic theory of gases; the ideas of lines or tubes of force; the principle of interlinked circuits; the principle of the growth of entropy in all thermo-dynamic changes.

Science, for which no use has been found, or which is not applied, is called "pure science," whereas it is really the raw material, and should be called "raw" or "crude science." There is an assumption of superiority in the term "pure science," and generally the term "science" is appropriated by workers in raw science in much the same way as the term "workingman" is appropriated to the exclusion of brain workers. There is supposed to be something noble and superior about "raw science," and its study is treated as the unselfish devotion to the interests of man, which is obviously entirely the wrong way round. The so-called "scientific man" thinks that engineers and manufacturers are ignorant and unscientific, and that their practical knowledge is of no account; and that the cure for all industrial evils is more technical education, more universities and more power to science masters. Though there are in existence a few practical science teachers, they are rare. Perhaps no one would be more surprised than the average science master if you told him he was unpractical and was, by his attitude and example, hindering science. He does not mean to. He is as keen as possible to do just the reverse, and is generally exceedingly anxious for the spread of science or technology; but, unfortunately, he has got a wholly wrong view.

It is often said that the pursuit of knowledge has a nobility of its own. But what knowledge? No knowledge is worth obtaining for its own or any other sake, unless it is or will probably be useful to man.

A man's value to the world at large may generally be roughly estimated by the income he earns. Where position is earned at the same time, the money income is in proportion less for a given usefulness; but taking such disturbing elements into account, the rule is broadly true. The business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant. Just as the raw scientist looks down on the engineer, and the engineer looks down on the business man, so the business man has a contempt for the engineer; and the engineer in his turn looks on the raw scientist as an unpractical crank. So much is this the case that the business man will not trust the engineer more than he can help. He assumes that if you know anything about anything you can not possibly be a business man.

If you examine the large industries you will find the commercial or business man with little or no technical knowledge at the top of the tree. If you confine your attention to engineers you will find the engineers

who make the biggest incomes and occupy the most important and responsible positions are those who have most business and practical knowledge. Our leading consulting engineers do not spend a large portion of their lives plotting curves, counting electrons, or even making anything more than arithmetical calculations. They spend their time dealing with large questions on purely commercial lines; and, as a rule, the bigger the engineer the more he knows about practice and business, and the less he knows about text-book science. I do not for a moment mean to say that text-book science is not of priceless value; of course it is; and the more scientific knowledge you or I, or still more, the leading engineers have, the better; but most of us suffer from too little common sense in proportion to our scientific knowledge.

The engineers occupying smaller positions, assuming the same age in both cases, are not necessarily deficient in technical knowledge; but they are generally wanting in business attainment and less able to take responsible positions. It is often said that to be a good master you must have been a good servant; but a good servant does not necesaarily make a good master, generally the reverse. There is a wide distinction between the man who can earn a few hundreds a year and the man who earns as many thousands. It is a very curious thing that there is hardly anything between. One type of man will either earn his few hundreds a year all his life, remaining permanently an assistant, or he will undertake responsible work and get into fair figures. The engineer who is worth $3500 a year seems hardly to exist, except for a short time on his way from one class to another. This is what is meant by the saying that there is plenty of room at the top of the ladder. It is not that the men who remain as assistants permanently are ignorant of science; quite the reverse. The business man can rent a profound mathemetician for a very few dollars a week if wants him; but he probably does not. The real point is that the assistant is wanting in business knowledge or in push. If he is wanting in ambition or lazy, nothing I can say is to the point; but he may be suffering from a false notion of the relative value of raw science, technology and business knowledge.

In the charter of the Institution of Civil Engineers the engineer is defined as "directing the great source of power in nature for the use and convenience of man." With all respect to this august body, and its often quoted definition, I would humbly suggest that it is bad. It is really the definition of a scientific man. It is incomplete as applied to an engineer, because it does not take into account the sordid element of price. An American definition is much better—"an engineer is a man who can do for one dollar what any fool can do for two." This is not poetical and is useless for oratorical purposes; but it is right. It is no use being able to design most complicated alternating-current machinery, or being able to explain it with the help of a wilderness of clock faces and several issues of the technical journals, unless the machine, when made, is cheaper than its rivals. Every design, every engineering manufacturer, and every piece of engineering is only a question of price. It is unpleasant, perhaps, but is a hard fact, and we have got to face it.

If one of us does $750 worth of work a year and earns $800, he is efficient; if he only does $450 worth he is an inefficient machine and will come to grief. He is like a ninety-kilowatt alternator which takes 100 kilowatts to excite, though the analogy is not close. If he does $75,000 worth of work and gets $50,000 he is an efficient machine of much larger size, and his efficiency is much more satisfactory to himself. I may mention, in passing, that an efficient man must do more work than he is paid for. This is not always realized. A man who only did what he was paid for would be of no use to the world at large. His efficiency is zero; his consumption being equal to his output. The man who does $75,000 worth of work and gets $50,000 consumes two-thirds of the work himself; so his efficiency is only thirty-three per cent; which is very high, even for an engineer.

We see, then, that the business man is the master; the engineer is his good slave; and the raw scientist is not good enough even to be the slave of the engineer; he has no market value at all, except as a teacher of more raw science. The raw scientist will remain at the bottom of the tree until he gets rid of the professional cant which pretends that raw science is pure, or nobler and superior to science as a whole; and the engineer wil remain in the middle position as long as he takes the middle view and considers engineering as something superior to money considerations, and as long as he looks down on business and commercial methods.

Views like these put forward in addresses do not alter the world at large, and they do not expect to do so. They are put strongly to warn you, who are young, and therefore inclined to be enthusiastic, against one of the greatest difficulties in getting on; that is to say, a poetic idea that there is something degrading or deteriorating in taking a money view of everything. You may say, "we take higher views of life than that; there is something better for us in our careers than money grubbing." So there is; I heartily agree with you; and when you have grubbed some money and are at liberty to end to higher things, I would e to be allowed to oin you.

It is cant to profess contempt for money. The poet professes to work for ame, and so does the musician, the artist, the philosopher, the scholar or the man of letters. They generally like money; but apart from that they are merely satisfying their proper vanity or love of approbation, by getting ahead of their fellows. But that is all you want to get on for. Money is nothing in itself, it is only a means, and making it is merely a way of getting ahead of your fellows. People who cannot make money do not like it being used as a criterion, so they run it down. Every one thinks

the world ought to be judged by what he can do best himself. If you want to be poets you have my sympathy, but I can not deal with you in this address. I can only ask you to eschew cant.

You may, on the other hand, ask "how are we to get business and commercial knowledge?" You may say, "you are much older than we; you were practising engineering several years before any of us were born. How did you get all your practical knowledge and become an engineer?" I can only answer, "I am only a very little bit of an engineer." I know I will never be much of an engineer. This is mainly because this practical difficulty in getting on has always been in my way. I am entirely out of sympathy with the whole of this part of my address to you. I so much dislike saying it all that I know it must be true.

I can not tell you how to be engineers, because I do not know. All I can do is to make you realize some of your wants; and if you know what you want you are more likely to get it. One of the greatest difficulties in getting on is to find a good opening. Then, as to the different branches of the business—business is really a higher title than profession—in which are you to find openings? From the number of applications I receive from young fellows, it seems to be a common idea that consulting engineering is a good thing to begin upon. This is a curious notion. A consulting engineer is supposed to be a highly skilled engineer, with so much experience that he is an authority. I should have thought at least twenty or thirty years' experience, apart from school and college training, was necessary for a consulting engineer to be worth his salt. But there are various grades of consulting engineer; and I am entirely at a loss to know what the qualifications of the consulting electrical engineer really are. Then still less do I know what the consulting electrical engineer will be by the time you have had twenty or thirty years' experience.

In manufacturing work there is the designing of dynamos, motors, transformers, and so on. This was considered high grade work when I was a young man; and even very able men built some very queer machines in those days; we were all pretty ignorant. There are many openings to be had in central station work, and stations are growing bigger and more important every day. Central station work in a position of responsibility is very anxious. I do not think it is very well paid, either.

A large number of young men go in for installation work—which sounds as if they started bishops on their episcopal careers—but really means that they do what is, in fact, electrical plumbing under an unnecessarily imposing name. There are a great many of them and they seem to spend most of their time going into and out of partnership with one another, like ions, and sending notices round to that effect. At other times they go bankrupt and send no notices. The upper grades in teaching science are well paid, more especially as a position goes with an appointment, and there is time and facility for original research, which is a luxury and brings reputation. Moreover, a steady income with no expenses is a very blessed thing. But the lower grades are very poorly paid in proportion to their ability.

All this may sound rather discouraging, but I am dealing with the difficulties of getting on, and I am sure it will not discourage anyone who is worth his salt. At first it is very discouraging to make very little, and the good man has little chance of showing his superiority to the common run. But he should always remember that income, as a young man, is very little criterion of real value. There are many careers in which a young man can make something almost at once; but in all cases the income increases very slowly. In such a business as engineering a man of first-rate ability may be quite unable to make enough to marry on until he is thirty, or enough to be comfortable on until he is forty. An eminent engineer, whose name you all know, said that he did all the hard work of his life for $7.50 a week, and when he was well on in life money came rolling in of its own accord. I have reason to believe that one of our foremost engineers, now dead, never made $2,500 a year until he was over forty.

Though you may not like it, a hard struggle is very good for a young man who has anything in him. It gets him into ways of overcoming difficulties, so that when he gets above the small obstacles he goes on overcoming large ones from the mere force of habit. Nearly all great men rise from almost nothing with infinite trouble in their youth. There is nothing worse for a young man than to have about $1,000 a year of his own. He lives comfortably and does not worry; and when he is thirty he wants to marry and finds he can not, and is too late to begin life seriously then. If any of you have this sort of private income he had better go into partnership in installation work for a year or two and then begin business seriously.

I have only mentioned a few of the difficulties of getting on. I am sorry to say there are many more, which you will find out in good time.—*Electrical Review.*

A recent study of the qualities which gasoline ought to possess for advantageous employment in automomobiles has reached the following results. It should be very limpid, possessing a density of 0.680 to 0.590 specific gravity and perfect homogenity. It should also have a low flashing point. The flashing point of American oils varies from 73° to 110° Fahr. It should not be forgotten that a motor employing oils having a low flashing point will work better than if using the higher. This quantity must be kept in view in the use of petroleum oils in motors.

Renew your subscription promptly.

ZINC ENGRAVING OR ETCHING.

N. S. TINKER.

In presenting the following instructions for the rapid etching of zinc printing plates, it is the intention to make them as clear as possible, so that even a novice can easily produce a good printing plate with very little practice.

The first process considered will be outline cuts. These are much the quickest and easiest to make.

Procure a piece of ordinary tinner's or, better, engravers' zinc, polish it thoroughly with powdered pumice stone or engraver's charcoal, and a wet cloth, being careful to remove all grease and stain. Then draw the required design on the zinc with a mixture of fine, black job printing ink, three parts, and oil of sassafrass, one part, using a No. 1 Spencerian pen for the purpose. You can fill in the heavy places with a camel's hair pencil. All straight lines across the face or "background" may be drawn by elevating the rule at both ends; a short piece of printers' column rule may be used nicely for drawing. You can determine whether the ink is too thick or too thin by trying it on a separate piece of zinc. If the ink is of the right consistency you will be unable to make quick strokes. Should there be too much oil in the ink the lines will spread when heat is applied to the plate.

When the drawing is finished to your satisfaction powder with a mixture of powdered asphaltum, two parts, and powdered dragon's blood, one part. This must be very fine to produce good results. After thoroughly powdering the lines drawn, dust off the superfluous powder, brush in all directions with a soft camel's hair brush and the design will appear as clear as before the powder was applied.

Heat the plate by holding it over lamp, gas jet or on stove top, until the lines turn black or until the ink fuses the powder onto the zinc. The correct heat will be indicated by a slight smoking of the powder.

Varnish the back of the plate with asphaltum varnish made thin with benzine or shellac. Use a quill brush for the purpose, and let the plate dry thoroughly.

Put the plate into a glass or porcelain dish into which has been put a mixture of one part of commercial nitric acid and ten parts of water. Have the acid thoroughly mixed with the water before immersing the plate. Move the dish so as to produce a washing or rocking motion, and let the acid eat the plate until you see the finest lines are being eaten away.

Wash plate off, remove from bath and rinse thoroughly in water; clean face with alcohol. With a roller put a coat of black printing ink on a piece of cardboard and lay face of plate on it and apply an even pressure. When the lines are well mixed, powder as before, brush in all directions, which will cause the powder to sheer to all sides of the lines; then heat as before directed.

Before immersing in the acid solution again, protect the fine lines that have been sufficiently etched by giving them a coating of asphaltum varnish. Etch about one-half through the plate, then re-ink, powder and heat as before. Use a heavier coat of ink this time to protect the sides. After etching nearly through the plate, rinse, clean face with alcohol, and back with benzine. A drop or two of the potash solution mentioned farther on will readily cut the composition on the face. Be careful not to injure face while cleaning. It is advisable to rub with ball of the fingers when cleaning. Trim plate close to lines, saw a block to size required and with a piece of soft paper between, glue plate to block with a thin coating of strong glue containing a small quantity of alcohol. When dry re-remove large open places and sink the smaller if necessary. This kind of cut can also be fastened to the base with small brads.

To make a lithotint cut, which is much easier than the outline cuts, follow the same instructions except that before fusing (heating the plate) you deposit a fine dust of asphaltum and dragon's blood on the plate by making a box thirty inches high and about eight inches square; have a door about four inches from bottom and across one side and even with the bottom of door stretch a few wires to act as a shelf for the loose-fitting slide on which you put the plate. Put about four ounces of the powdered asphaltum dragon's blood mixture in the box and, after shaking it from end to end several times, open the door and insert the slide containing plate. Withdraw in about eight seconds and, if not satisfactory, brush plate and try again. A heavy shower of dust will bear deeper etching than light showers.

After the dust particles have deposited themselves evenly on the plate, fuse as in the outline cuts. By re-inking the lithotint plate once, as described for outline cuts, you will avoid ever having a blurred lithotint cut on your press. Owing to the quickness with which these cuts can be made they are of special value to printers who are located where engravers are not readily accessible, and with a little experience you can imitate a half-tone surprisingly well. A border should always be used around lithotint cuts, as it adds much to the appearance.

Select the cut or matter to be reproduced, put in a job-press, take a heavy and well-inked impression with a good, black job ink on unsized paper, lay face down on zinc and subject to heavy pressure. Remove paper, and if the quantity of ink on paper was sufficient you will notice the design or letters distinctly transferred to zinc. Powder and etch as previously described. There is more or less difficulty in reproducing from type smaller than a bold-face 12-point or from

a high-grade engraving, drawn in fine, close lines, as this process is not intended for work, although good results may be obtained by persistent efforts.

To make a transfer to zinc of a cut, etc., which has been printed on an ordinary paper with news or job ink, first go over the pages with a solution of two parts caustic potash and three parts of alcohol. Then immediately immerse in the etching bath. Let it soak thoroughly, then remove from bath and absorb loose fluid with blotters, lay face down on the zinc and with a piece of stereotyper's cloth on top, subject to heavy pressure, using a paper cutter clamp or copying press to get sufficient pressure. Then proceed as described. Photographs, and the like, which will not transfer as above, will have to be gone over with the tracing ink and then transfered.

To make a plate of manuscript, or other written matter, transfer to zinc in the ordinary way, trace with the prepared ink and proceed as usual. Sometimes, when the manuscript is very old, it is necessary to go over it with India ink to make it transfer. By means of a photograph a tracing can be made and quickly transferred to zinc. Judgment should be exercised in fusing a lithotint cut, because, should you burn the powder its then easily affected by the acid in the bath.

After transferring, should any particles of paper remain in the zinc let them dry, and remove by carefully rubbing with a soft, clean cloth. Keep all the chemicals fresh and clean and, when not in use, in tight stoppered bottles. The bath wastes away in open air and has to be renewed freqnently when in use. In etching, as in other vocations, he that would attain to eminence must persevere and he who "tries again" is soon cognizant of the fact that "Success" is a companion to "Diligence." This process of engraving opens up a new vocation for the young people, and where newspapers are published there is a constant demand for illustrations of current events.

VIBRATOR FOR INDUCTION COILS.

H. C. BURNHAM.

The difficulties encountered with vibrators of induction coils are, that the contacts are liable to fuse or burn, and that the core is not fully magnetized so that the full power of the coil is not produced in the sparking. To overcome the first we must have a spring that upon magnetizing the core will break the circuit quickly. To overcome the latter we must have a vibrator that will work evenly and be slow enough to allow the core and primary to become fully energized, thus securing the best results in the spark of the secondary.

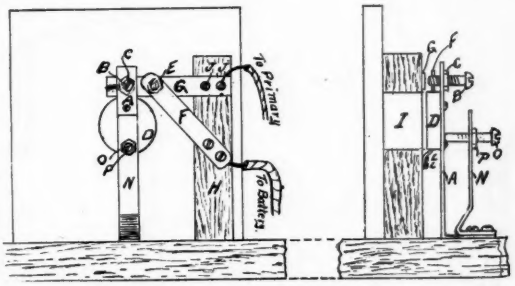
The vibrator here described will accomplish these results. To make it procure a strip of spring brass, *A*, 3 in. long by ¼ in. wide. (It must be very springy and so that it will bend with a very slight pull.) At one end measure off ⅝ in. and bend to a right angle. Drill two holes in this short bend for screws; at the other end, ¼ in. down and in the center, drill a hole 3-16 in. in diameter.

Next, get from a hardware store a small brass machine screw ⅛ in. diameter, with a nut to fit. Solder this nut *c* over the hole just mentioned. Also obtain a round piece of soft gray iron, *D*, ⅝ in. in diameter, saw off a piece ¼ in. thick and rivet it on to the spring *A* so as to be exactly opposite the end of the core and directly face to face with it.

Next, get a piece of cherry *H*, 2⅝ in. wide and of the same thickness as the end of the core which projects from the end of the coil. On my coil this is ¼ in. Screw this to the brass so that it fits snugly against the end of the coil, and is ⅛ in. from the outer edge of the coil head, as shown in the illustration.

Procure a piece of very heavy spring brass *c* 1⅝ in. long and ¼ in. wide. Drill two holes in this piece for the screws *J J*. Screw this piece to the block *H* so that it is long enough to go about ⅛ in. beyond where the screw *B* strikes it. One inch from the outer end solder a piece of sheet platinum about 3-16 in. square in the center of the point of contact with the spring *F*.

Now take a piece of brass 1½ in. long by ¼ in. wide



and 1-16 in. thick. Drill two holes for the screws *L L*. At the other end drill a hole 3-16 in. diameter and 3-16 in. from the end. Get another brass machine screw 1-8 in. wire, with nut to match. Procure a piece of No. 12 platinum wire 1-8 in. long. Solder this to the end of the machine screw, then solder the nut to *F* so that it centers on the 3-16 in. hole previously drilled near the end. Mount this piece of brass so that the platinum tipped screw E centers on the piece of sheet platinum soldered on to *G*.

Take another piece of brass 2 in. long by ¼ in. wide and 1-16 in. thick and a brass machine screw 1-8 in. wire with a nut to match. Drill a 3-16 in. hole ¼ in. from

the end and solder this nut *p* over it. Bend this piece so that the screw-hole will stand out about ¼ in. from the piece *A*. Mount this piece *N* with the same screws that hold the piece *A*.

Now for the adjustment. Mount the spring *A* so that the iron disk *D* is about 3-64 in. from the core *I* and is directly line with it. Mount the strip of cherry so that the screw *B* hits the spring *G* about ¼ in. from the end. The strip *F* is to be mounted on the piece of cherry so that the screw *B* hits the spring *G* about ¼ in. from the end. The strip *F* is to be mounted on the piece of cherry so that the platinum tipped screw centers on the piece of sheet platinum. See that the spring *G* bears strongly against the screw *E*. Adjust the screw *B* so that just before the iron disk *D* touches the core *I*, the screw *B* will strike the heavy spring *G*. Adjust the piece *N* with the screw so that the weak spring *A* can only fly 3-64 in. back from the core *I*.

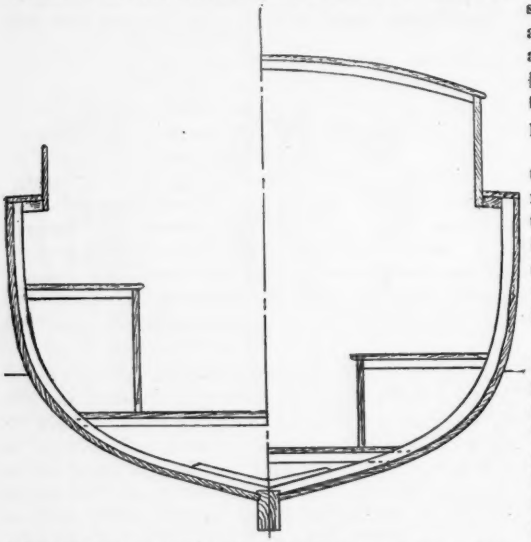
Now for the connections. Under the screws *JJ* solder a wire and connect it with one of the primary wires. Solder a wire to the piece *F* and run it to the binding post for the battery.

HOW TO BUILD A POWER LAUNCH.

CARL H. CLARK.

II. Laying Out the Lines.

The keel is a straight piece of oak 3 in. thick, 5 in. wide and 17 ft. long. It should have a slight upward bend forward, to conform to the shape of the mould already made. The deadwood and stern post are built up in the manner shown, and the horn-timber forming the overhanging stern is fitted on the top and fastened down through. The deadwood is swelled slightly around the shaft hole. The stern-post should be mortised into keel and horn-timber to hold it firmly in place. The hole for the shaft is 1¼ in. in diameter.



It had better be bored before the keel is set up, as it is more accessible then. It should be located as follows: Measure up on the after side of the stern post 12 in. and at section No. 6 measure up 15 in.; a line drawn between these two points locates the center of the hole. This line is then drawn on the deadwood and used as a guide in boring. Care is to be taken that the hole is in the center of the deadwood, and it may be well to bore a small hole before putting the large one through. A ship carpenter's bit should be used for this work, as it is longer and bores straighter than the ordinary ones; it is not expensive.

The stem is a natural crook knee which is fitted and scarphed to the forward end of the keel. It is 3 in. thick and has a rabbet cut in it to agree with the line marked on the mould for that purpose. The rabbet should be at least roughed out before fastening to keel, and the forward edge bevelled off from the rabbet to about ⅛ in. thick. It is fastened to the keel by several ⅜ in. galvanized iron rivets. The form of scarph should be noted, as it prevents the drawing apart of the two pieces.

The after end of the keel and stern post should be thinned down to about 2 in., and the corner slightly rounded except at the shaft hole, where it is left full thickness and square, to give fastening for the stern bearing. In every joint of the frame stop-waters should be fitted, as has been before explained, to prevent the water running along the joint and into the boat.

When the foundation is complete the mould should be laid on and checked up to make sure that it is correctly put together. The water line and mould positions are also marked across stem, sternpost and keel. The rabbet in the keel and deadwood can be cut approximately now; as will be noted, there is a back rabbet above the plank of about ¼ in; this is to give a solid backing for the calking to bed against and makes the boat more durable. It can be roughed out now and trimmed out fully after the moulds are set in place.

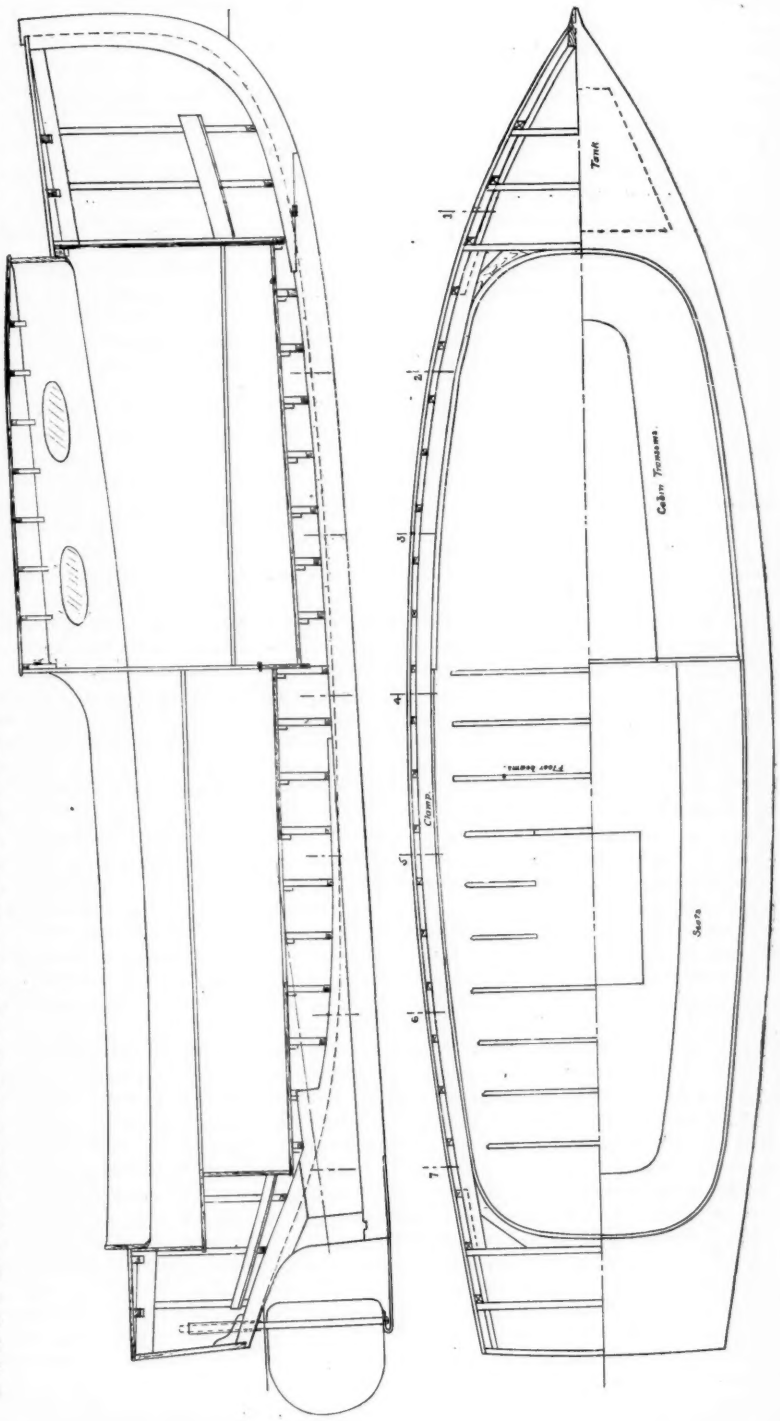
The keel may now be set up on blocks with the water line horizontal; the blocks must be well braced and the keel have a good bearing on all so as to remain straight. The stem must also be plumb when looked at from forward. Bracing beams are run from

the top of the stem to the beams overhead.

The stern-board is gotten out next from a piece of 1¼ in. oak plank, not forgetting to deduct from the outline the thickness of the plank. It is to be noted that the form given is for the after side of the stern-board and, owing to the sloping sides, the forward face of the stern-board is larger than the after face; for this reason the edges of the stern-board must be left with a considerable amount of bevel, to be trimmed down to the correct angle after the ribbands are in place.

The sternboard is now to be fastened to the end of the horn-timber and at the correct angle, as shown by the template. It is set into the end of the horn-timber, as shown in the sketch, being set down to within ⅜ in. of the rabbet. This is necessary, as the rabbet represents the outside of the plank, while the stern-board goes inside. A knee is fitted in the angle between stern-board and horn-timber and well fastened to both. Care must be used in setting the stern-board to place it square with the keel and with its center line vertical. A line should be stretched from its center line vertical. A line should be stretched from the center-line of the stern-board and that of the stem, and care taken that it is directly above the center line of the keel. These two govern the fairness of the hull and must be correctly adjusted.

As before directed, the moulds are made of any rough stock, but must be strong. They are now to be set up in their proper places on the keel, the foot being cut out to allow the lower corner to come to such a



point that when the plank is laid on, the lower edge will come to the rabbet line. The moulds are to be very carefully set, vertically and square with the keel, and fastened to it securely. When the moulds are correctly set the L. W. L. as marked on every mould should be in the same level line. Ths line between the stern-board and stem will aid in setting the moulds; the centre line of each mould being brought directly under it.

When the moulds are all set they must be securely braced in each direction. There is considerable strain on the moulds during the process of timbering and they must be strongly braced in order not to be forced out of position. Ribbands about 1¼ x 2 in. are now bent around the moulds from stem to stern and fastened to each mould with screws. These ribbands should bear fairly across all the moulds, and if they do not there may be either some error in laying off the moulds or in setting them up, and the error should be looked up and carefully rectified before going further.

The frames are of oak about 1¼ x 1¼ in. and are spaced 10 in. in the boat. Stock for this purpose must not be too dry, or it will break when bent, even though it is steamed. The frames should be sawed out to size and long enough to reach from keel to gunwale. They will, of course, require steaming before bending, and a steam box will be necessary. It should be a fairly tight box about 6 x 12 in. and long enough to accommodate the longest pieces. It will be well to make it about 12 ft. long as there will be some long pieces to steam later in the work. It is connected to some source of steam, a small boiler, of course, being the best, but for want of this a teakettle and oil stove will answer. A considerable amount of steam is, however, required, and it must be as hot as possible, to be effective. The frames are notched out to fit the keel at the heel, which should be done before steaming. As many as possible should be placed in the steam box, which is closed tightly and steam turned on. They are steamed until thoroughly limber. The frame points should be marked on keel and ribbands, being so spaced that each mould will come in between two frames. As the frames are taken from the steam box they are first bent over a form to a greater curvature than desired, and are then put into place and clamped to the ribbands; the two corresponding frames should be put in at the same time, thus keeping the strain equal. It is well to fasten the tops of the opposite frames together with a piece of rope to overcome any tendency to spring outward.

The frames should be allowed to set and thoroughly dry out in place before any of the fastenings are disturbed. If the frames have been well steamed there should be no tendency to spring after a day or two. The clamps may then be taken off and the ribbands fastened to the frames with screws, as the clamps will be needed for other purposes.

The rabbet should now be trimmed out to the proper angle, that the planks may lie on the frames and bed fairly. It is then ready for planking, which will be the subject of the next article.

NOTE.—In the laying off table published in the last issue the following corrections should be made:

In ht. of sheer above base line						read	4′	4½″	for 4′	4 ″
“	“	rabbet	“	“	“	“	0′	11½″	“ 1′	11½″
“	“	keel	“	“	“	“	2′	5⅜″	“ 2′	5 ″
“	half breadth. L. W. L.					“	1′	8⅝″	“ 1′	8½″

PHOTOGRAPHY NOTES.

To one whose lot brings him in constant contact with beginners and their productious in the photographic line, nothing seems more of a hindrance to their advancement than their uniform inability to determine whether certain results are due to under or over-exposure on the one hand, or under or over development on the other. Often I am sent prints that are clearly faulty from over-development in an unsuitable developer, and yet the sender goes to the trouble to explain that he is aware that the plate is over-exposed because the high lights are so chalky. Another will send in a print from a sadly over-exposed negative; one so badly over-exposed that the securing of proper density was out of the question except by most careful treatment, and he will explain that owing to the exposure being too short for the poor light everything comes out black in the print. It would seem needless to point out that both are wrong, and yet the error is a most common one. Let us go over the matter of a few negatives. One that gives a chalky looking print is clearly an under-exposed negative, or else it was correctly exposed and developed too long or with a too strong developer, possibly both. If you find yourself making such negatives, I would advise the employment of a more dilute developer, particularly during the warmer months, when the action of all the chemicals is accelerated by the increase in the temperature. If you have been using one of the ready prepared developers, try using Rodinal, diluting it to the limit advised on the formulæ sheet. Should development beceme too prolonged it is an easy matter to add a little of the concencrated solution. On the other hand, if your negatives have an inclination to be of character that gives you very dark prints with no high lights where they should be in the print, you are evidently giving exposure of too long duration. Try a developer that is stronger, and if possible cut down the amount of alkali in the formula used. Of course you will shorten your exposures, but there is another cause that may be to blame for the unsatisfactory nature of your negatives. Their thinness may be due to fog caused either by a leak in the camera, or through the use of an unsafe developing light. Carefully covering the camera with a focussing cloth will guard against the first, and covering the tray during development will guard against the second, at least for an exposare or two, to determine where the fault lies.—*Fayette C. Clute in Camera Craft.*

JUNIOR DEPARTMENT

For the Instruction and Information of Younger Readers.

ELEMENTARY MECHANICS.

J. A. COOLIDGE.

XI. Pumps.

In our last paper we studied barometers and siphons and learned that the air exerted such a force downward that a column of mercury 30 in. high would be held up in a barometer. If we wished to make a water barometer we should need a tube over 34 ft. long. Such a barometer has been made, but is too clumsy to be of any practical value. We also find air pressure playing an indispensable part in our common lifting or water pumps, and many a column of water in a pump is held there by the pressure of air upon the water in the well.

Let us make a rude model of a pump in order to study better the working of larger pumps. A lamp chimney from a students' lamp should be fitted tightly at its small end with a disc of wood about $\frac{1}{2}$ in. thick. In this a hole from $\frac{1}{4}$ to $\frac{3}{8}$ in. inches in diameter should be bored. A piece of tubing, *C*, glass, if possible, (a piece of metal will do. Even a piece of a "bean-blower" would answer) about 5 inches long should be fitted in *A* and a valve *V* to cover the hole should be made from a piece of leather and should be fastened by a tack in the upper part of *A*.

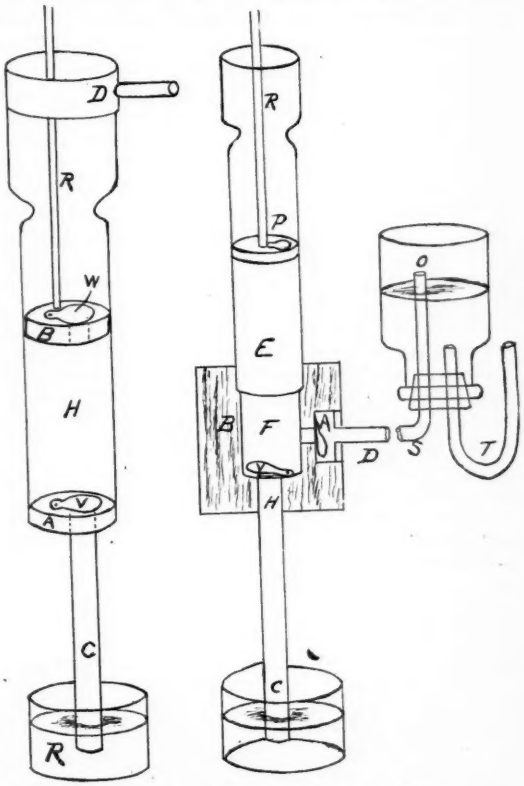
The piston *B*, made similarly to *A* but fitting more loosely into the chimney, should be attached to a rod *R* and should have a hole of the same size as in *A* with another leather valve covering this hole.

If we are content to let the water run over the top of the pump and do not care where it goes, our pump is complete. If, on the other hand, a spout is desired, one may be made in the following manner:

A collar of paper or pasteboard or several thicknesses of paper (see *D* in the figure) should be glued tightly to the top of the glass chimney and extend above it $1\frac{1}{2}$ inches. In this a spout should be fastened as in the figure. A piece of some substance, as *C*, about one inch long is sufficient. This collar should be thoroughly varnished or waxed, so as not to soak water. If one prefers to bore a hole through the chimney instead of making such a collar, he can do so with a rat tail file and turpentine. It is a laborious task to make a clean hole large enough, but will repay for the work done.

EXPERIMENT XXXVIII.

Place the pump with tube *C* under water. Push down the piston *B*. If *B* fits tightly in the pump cylinder or chimney, the air in the cylinder below *B* and above *A* will be compressed and exert a strong downward pressure upon valve *V*, and equally strong upward pressure upon the valve in *A*. The result of that pressure is to shut *V* more tightly than ever and to push open the valve in *B*. The air in *H* escapes. On the upward stroke of *B* the size of the space *H* is increased and the air above tries to rush in fill this space. It cannot succeed as it merely pushes down upon the valve *W* and closes it, the air pressing upon the water



in the cistern *R* pushes it up through *C*, forces open the valve *V* and enters *H*. The next downward stroke of *B* causes *V* to shut and the water in *H* forces its way through *W* and above *B*. The next upward stroke lifts the water above *B* until it flows out through the spout *D*. Water from the cistern will continue to flow in through *C* as long as the water is lifted from *H*. The most difficult thing to understand is how the air pressure downward, caused by the weight of the air upon the water in *R*, can be transformed into an upward push of water in *R* and in the tube *C*. But as fluids

exert pressure in all directions, this change of directive force is similar to the weights on the two pans of a beam balance. The air upon *R* balances the water in *C*, and as long as the tube *C* furnishes the opportunity the pressure on *R* will force the water through *C* until there is a balancing of weights. If everything were perfect the water would rise 34 ft. in any tube from which the air were removed. In an actual pump, because of imperfections, 24 ft. is about as high as the water will rise in the pump log.

In case our pump will not work at first because of *B* fitting too loosely, a little water may be poured in the top as is often done with an actual pump by a roadside in the country.

THE FORCE PUMP.

Take a block of wood at least 3 in. square and with an extension bit [Such a bit may be had of AMATEUR WORK for a reasonable price], bore a hole *E* 2 in. diameter 1 in. deep, with the same center, continue this hole *F* 1 in. diameter another inch, and with a bit large enough to hold the tube used in the common pump finish this hole through. In this hole the tube *C* is to be fastened. At the upper end of *H* a small leather valve *V* is fastened by means of a tack. In one side of the block bore another hole *A* 1 in. diameter and 1 in. deep. Continue this with a $\frac{3}{8}$ in. bit through to *F* and make another valve that will drop and cover the hole, as in the figure. Make a $\frac{3}{8}$ in. plug to fit this hole and fit into this a tube, *D*. After making these holes it would be well to paint our block inside and out with melted paraffine. One inverted chimney will fit in the hole, *E*, and may be fastened in with putty. The others should fit very tight and can be stuck in with shellac. If these joints are waxed with paraffine they will be waterproof.

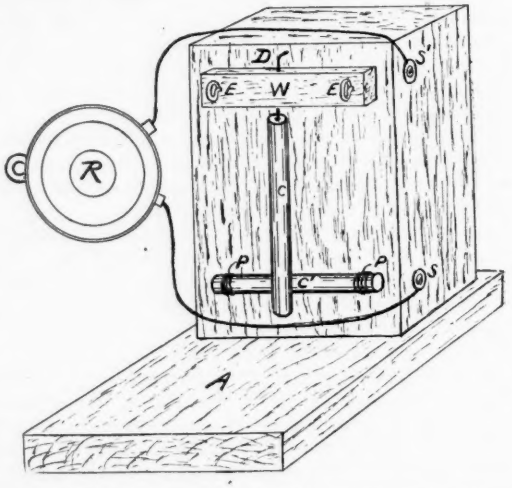
A piston, *P*, similar to the one used in the tube but of *solid wood*, should be made and fastened to a rod *R*. Our pump is now ready for work. As made it may not not pump air, but should pump water. Invert the pump, pour water through *C* until *E* and *F* are filled with water and water runs out through *D*. Hold the fingers over the end *D* and set the pump upright in a vessel of water. Push down the piston *P* and the pressure of water in *E* will close valve *V* and send out a stream through *D*. Raise the piston *P* and the pressure of air outward will press against *A*, shutting valve there, but will force the water up through *C* and valve *B*. Upon each downward stroke of *P* water will be forced out at *D*, and on each upward stroke water will be pressed up through *V* and fill the space *E* and *F*.

If a continuous flow should be wanted the tube *D* should be replaced by a bent tube, such as *S*, which should pass through a stopper into an inverted bottle. *O*. Another tube, bent as *T*, should pass through the same stopper. Holes may be made in a cork stopper by means of a rat-tail file, and bent tubes may be obtained at a druggist's, if no other dealer in town keeps them. With such an air chamber a continuous flow of water from the tube, *T*, may be obtained. The working of the valves is the same as above, but as the water passes from *S* into the chamber, *O*, and covers the opening of *T* the air in *O* is compressed and exerts a continuous pressure on the surface of the water in *O*. When the water is entering *O* through *S* the pressure is forcing it out through *T*; and when not entering, *i. e.*, the up stroke of *P*, the valve *A* prevents any water from being forced back through *S*, and the compressed air continues to keep the water running in a steady stream through *T*.

In some cases two pumps are connected with the same air chamber, and the piston of one is rising while the other falls, so that in any case there may be had a stream flowing uniformly from the hose or pump spout.

A MICROPHONE.

A microphone is one of the most important and interesting electtrical instruments which the amateur who is interested in electricity can construct. And, although extremely sensitive in its action, it is very simple in construction. For these reasons the one here described will be found of interest to those who are studying telephone work, as from it the principles governing the transmission of minute and varying currents can be readily studied.



The materials required include several short pieces of arc-light carbon, a cigar-box, two screw-eyes, a small three-cell battery such as used in night lamps, and a telephone receiver. The latter can also be made by the reader as described in the December, 1902, number of this magazine.

The illustration shows the general construction, *A* being a base board for holding the cigar-box upright, *C* and *C'* being pieces of arc-light carbon about 4 in.

long. A piece of wood W, 4 in. long and ½ in. square is attached near the top with the two screw-eyes E, first boring holes ⅜ in. from each end so that the screw-eyes will slide freely therein. Two small springs ½ in. long are made of fine brass wire, which may be easily done by winding the wire around a wire nail of a little larger size than the serew-eyes ; the latter must be, therefore, about 1½ in. long in the straight part, but may be of small wire gauge.

The piece of carbon C' is first attached to the box by winding two or three turns of bare copper wire P tightly around each end and then carrying the ends through holes bored in the box, and there joined together by twisting several turns close to the box and then connecting to the inside end of the screw or binding post S.

The piece of wood, W, also has a vertical hole bored in the center to receive a short piece of flexible telephone wire, D, the lower end of the latter being fitted into a small hole drilled in the end of the other piece of carbon C, and held firmly in place by a wooden plug or by soldering. It will be seen that by turning the screw-eyes in or out the pressure of the carbon C on the piece C' can be nicely adjusted. The inner end of the wire D is carried to one terminal of the battery, which is simply placed inside the cigar box. The other terminal of the battery is connected to the inner end of the screw S'. The telephone receiver R is then connected by flexible wires to the outside ends of the screws S and S', small washers having been placed under the heads to give greater and firmer contact.

In operation the microphone should be placed on a firm, level surface and the piece W adjusted by turning the screw-eyes E so that the carbon C rests very lightly on the piece C'. By placing the receiver to the ear the faintest sounds will be transmitted to the ear. A fly walking on the box will cause a quite audible sound, and the ticking of a watch on the top of the box will seem like a tremendous racket. By carrying wires connecting the receiver to another room, considerable amusement may be derived by having visitors guess the cause of the sounds that are heard in the receiver and then seeing their astonishment upon being told the real cause.

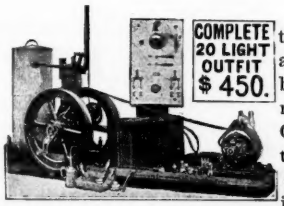
SCIENCE AND INDUSTRY.

In a paper read by Mr. F. S. Greene before the New England Cotton Manufacturers' Association, the claim is made that for power transmission in textile mills ropes are superior either to belting or electricity. The power may, he states, be thus economically transmitted a distance of 500 ft., and the two shafts coupled by the rope need not be in the same line. As compared with belting, a rope pulley is only half to two-thirds the width of a corresponding belt pulley. A rope drive is, moreover, noiseless, and electricity is not generated in the same way as it is with belting, with which constant trouble is experienced under this head in New England cotton mills. In cases in which 200 h. p. or more is to be transmitted, and where the shaft centers are more than 30 ft. apart, rope transmission is, he claims, much cheaper than electricity or belting. Estimates made for a mill in which a total of 1500 h. p. had to be distributed to three floors showed that the total cost of transmitting the power by ropes would be $4941, by belting $5999, and by electricity $25,400. At need, shafts less than 30 ft. apart can be driven by ropes ; and Mr. Greene quotes a case in which 100 h. p. is transmitted by ropes (with a quarter twist) between shafts only 16 ft. apart and at right angles to each other. In this case, moreover, in order to get the requisite speed in the follower, it was necessary te use pulleys less in diameter than the usual standard minimum of 40 times the thickness of the rope. In fact, the small pulley is only 34 in. in diameter, and on it run ten 1½-in. ropes, the speed being 5150 ft. per minute.

Palm kernels, which are the product of the palm-oil tree, are very important in the life and trade of the native African. They have a varied utility, but are principally used for making an oil called nut oil and a sort of butter called palm butter. Abroad they are used for the manufacture of soap, candles and artificial butter. The finest groves of oil palms are in Liberia at Cape Palmas, where for miles the graceful trees wave their branches. The decline of Liberian coffee has caused some farmers to consider the palm as a possible staple upon which to bestow their future labors.

We of the North are helping to ruin the next generation of Southern pines by lavish use for decorations of the young trees of about two feet high, crowded with the long drooping emerald needles. The little cut-off pine lasts a week or two in a parlor—it took four or five years to grow!

TRADE NOTES.



The illustration shows the No. 3, belted stationary, 20-light outfit sold by the Richardson Engineering Co., Hartford, Conn. This is but one o the many combination or isolated electric lighting plants shown in the catalogue of this company, and is a most complete, useful and practical outfit for residences, farms, summer cottages, whether at shore or mountain, and for small requirements where simplicity and compactness are an object. This outfit will light five 16-c. p. lamps for 9 hours, or seven lamps for 5 hours, or three lamps for 16 hours on one full charge of the storage batteries. The size of house for which this outfit is designed will average three or four lights burning at one time,

therefore one charge of the battery will last from four to six days and will require about one gallon of gasoline for operating the engine to charge the battery. It will be seen from this that the cost of operation is much below that charged for current by lighting companies, and merits the serious attention of anyone who is interested in lighting by electricity. Isolated plants for residence lighting are quite common in England, where commercial lighting rates are lower than in this country, and will undoubtedly be installed more generally here, now that complete outfits with the necessary directions can be purchased of one company.

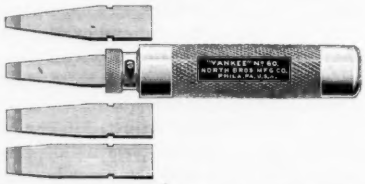
Pattern makers, whether amateur or professional, will find many tools of interest in the catalogue of the Stanley Rule & Level Co., New Britain, Conn. The various tools manufactured by this firm are all of the highest material, workmanship and finish, so that a purchaser of any tool marked "Stanley" can rely on its being a good one.

The "Duplex" Pencil Pointer, sold by Kolesch & Co., 138 Fulton St. New York City, as shown in the illustration, represents a great improvement over the ordinary sandpaper pads, while its extremely low price speaks for itself. It consists of a nicely finished and nickel-plated, semi-oval tin tube, which serves as a handle. Sliding in this and held by friction is a V shaped spring mounted with a piece of emery cloth, which serves as abrading surface. A circular channel at the bend of this spring serves as a receptacle for the lead filings, whence they can be easily shaken out without soiling the hands.

To sharpen a pencil, press the point slightly into the groove formed by the spring and draw it lengthwise from end to end, holding it steady when a flat point is required, and rotating it for a round point. The spring will adjust itself automatically to the proper contact and, owing to the curved abrading surface, a perfect point is obtained. The emery cloth will last for months; if worn it can be easily renewed by removing the spring, in which a new sheet is inserted, whereupon it is replaced in the handle. This pencil pointer, on account of its perfection, simplicity, durability and moderate price, recommends itself to every craftsman or engineer.

The attention of readers is called to the advertisement of Hammacher, Schlemmer & Co., New York City, which appears on the front cover of this issue. This old and well known firm have lately occupied new and enlarged quarters on 5th Ave., corner 13th St.' where they have every facility for displaying their exceptionally large and well selected stock of hardware and supplies. The firm has always made a specialty of orders received by mail, and intending purchasers can order with the satisfaction of knowing that all orders will receive prompt attention. A special department is devoted to manual training school needs, which will be greatly appreciated by purchasers for such schools, as it enables them to purchase all the tools and supplies of one firm. A personal visit to their new store will well repay any mechanic, either amateur or professional.

The pocket screwdriver here illustrated and mannfacted by North Bros. Mfg. Co., Philadelphia, Pa., is the best thing of the kind on the market. Four different size blades are provided, all of which are contained



in the hollow handle when closed. The operation of selecting a blade and fastening in the handle is quickly done, and when in place the blade is rigidly fastened. They are now being supplied the trade and will soon be obtainable of any representative hardware dealer.

The new motors and dynamos recently advertised in these columns by Kendrick & Davis, Lebanon, N. H., are made in the same thorough and efficient manner which characterizes all of the product of this well-known firm. Every care has been taken to produce in these new machines the best which can be made. The prices at which they are sold are also quite as attractive as are the machines themselves. Every reader interested in electricity should send for the new catalogue No. 7.

The gas engines manufactured by the Carlisle & Finch Co., Cincinnati, Ohio, are particularly well adapted for running the dynamos of small electric lighting plants, or other requirements where small power is needed. They can be purchased completely finished and ready to run, or the castings in the rough or partially finished can be obtained by anyone desiring to machine their own engine.

The special attention of our readers is called to the advertisement of the Frasse Co., 32 Cortland St., New York City. In it will be found mentioned many useful tools which can be purchased, while the stock lasts, at exceptionally low prices.

E. C. Atkins & Co., Indianapolis, Ind., manufacturers of saws, knives, etc., are issuing a very artistic calendar which will be sent to manual training teachers upon request. It is well worth writing for.